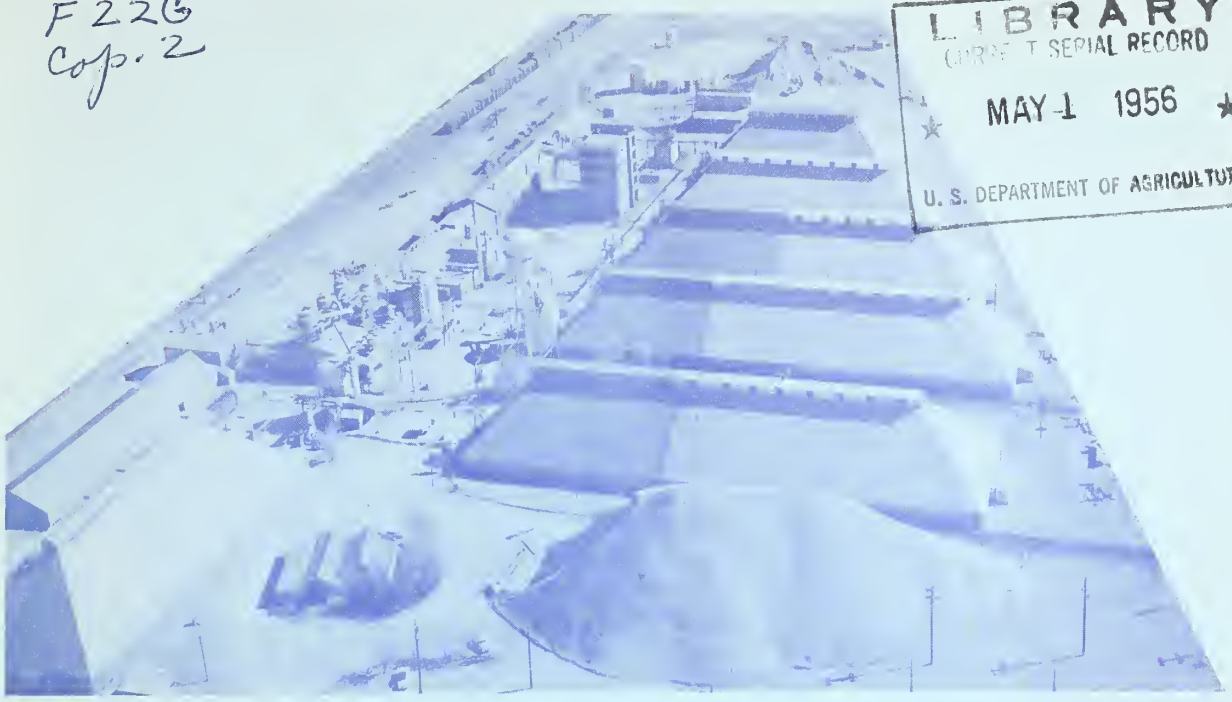

Processing and Marketing Cottonseed COOPERATIVELY

BY WARD W. FETROW,
DANIEL H. McVEY
AND JANE L. SCEARCE

FARMER COOPERATIVE SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

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CORRECTION

On page 23 of General Report 21, Processing and Marketing Cottonseed Cooperatively, the pictures were inadvertently switched. The picture in the center right should have been in the left panel, and the railroad car in the right panel to conform to the captions under the pictures.

FARMER COOPERATIVE SERVICE
U. S. DEPARTMENT OF AGRICULTURE
WASHINGTON 25, D. C.

JOSEPH G. KNAPP, ADMINISTRATOR

This publication is designed for use of cotton gin and cottonseed oil mill employees, groups interested in similar activities, colleges and universities, and others interested in marketing cotton and its products.

The authors wish to express their appreciation to the cooperative mill officials who supplied information and photographs for this report.

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, merchandising product, quality, costs, efficiency, and membership.

The Service publishes the results of the studies; confers and advises with officials of farmer cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

This study was conducted under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

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PROCESSING AND MARKETING COTTONSEED COOPERATIVELY

By

Ward W. Fetrow,* Daniel H. McVey, and Jane L. Scearce
Cotton and Oilseeds Branch

An estimated 50,000 cotton growers of this country are increasing their returns from cottonseed by owning and operating their own cottonseed oil mills on a cooperative basis. In some cases individual farmers have set up the cooperative mill. In others cooperative cotton gins, made up of individual growers, have formed the organization. Still others have both individual producers and cooperative gins as members.

This report will give in some detail information on the organization, services, operating methods, and policies of these organizations and the technical processes involved in crushing cottonseed.

The cottonseed oil milling industry was well established when farmer cooperatives first entered the picture. Before ownership and operation of cooperative cottonseed oil mills, farmers made several attempts to increase their returns from cottonseed. Most significant of these was that made in 1914 by the Scott County Association of Scott, Ark. This association sold cottonseed direct to oil mills, charging a commission of 50 cents a ton. Only with the organization of cooperative mills, however, were farmers able to make any real progress.

Little reliable information is available as to the number of cooperative cottonseed oil mill associations operated before 1900. A farmers' cottonseed oil mill association was formed at Italy, Tex., in 1890 and operated a few years. In 1912, the United States Department of Agriculture reported that a group of farmers at Glendora, Miss., operated a profitable oil mill business. The Farmers Union of Texas owned and operated a cottonseed oil mill at Vernon, Tex., from 1918 to 1931.[1]

The 14 associations operating in 1954 were organized during the period 1922-50 with half organized in the early 1940's (Table 1). Another association, organized in 1937, operated as a cooperative until 1950 when it was leased to private interests.[2]

*Mr. Fetrow, former Chief, Cotton and Oilseeds Branch, retired in April 1955. Credit is due Otis T. Weaver, present Chief, Cotton and Oilseeds Branch, for review and helpful suggestions on this report.

[1]Gatlin, George O. Cooperative Cotton Marketing. U. S. Department of Agriculture. 1926. Herrmann, O. W., and Gardner, Chastina. Early Developments in Cooperative Cotton. Farm Credit Administration Circular C-101. March 1936.

[2]Delta Products Company, Wilson, Ark.

Table 1. - *Name, location, and date organized of cooperative cottonseed oil mills*

Name of oil mill	Location	Date organized
Minter City Oil Mill	Minter City, Miss.	1922
Farmers Cooperative Oil Mill	El Paso, Tex.	1934
Tornillo Cotton Oil Mill	Tornillo, Tex.	1934
Delta Products Company[1]	Wilson, Ark.	1937
Plains Cooperative Oil Mill	Lubbock, Tex.	1937
Ne-Tex Cooperative Oil Mill	Wolfe City, Tex.	1939
Producers Cooperative Mill	Midlothian, Tex.	1941
Helena Cotton Oil Company	Helena, Ark.	1942
Mid-West Cooperative Oil Mill	Hamlin, Tex.	1942
Cen-Tex Cooperative Oil Mill	Thorndale, Tex.	1943
Delta Oil Mill	Jonestown, Miss.	1943
Producers Cooperative Oil Mill	Oklahoma City, Okla.	1944
Osceola Products Company	Osceola, Ark.	1945
Valley Cooperative Oil Mill	Harlingen, Tex.	1950
Ranchers Cotton Oil	Fresno, Cal.	1950

[1]Leased to private interests in 1950.

All 14 mills are in areas of heavy cotton production. Texas, largest cotton producing State, leads with 8.

From the standpoint of total volume of seed processed, cooperatives that mill cottonseed are relatively unimportant, since they normally crush only 5 to 8 percent of the seed produced. However, these cooperative mills exert influence in various ways upon the industry much greater than their volume indicates.

Table 2 shows volume of seed crushed by cooperative mills for the 7-year period, 1947-48 to 1953-54. Tonnage crushed by individual mills ranges from around 10,000 tons to more than 100,000 tons.

Table 2. - *Tons of cottonseed crushed, cooperative cottonseed oil mills, 1947-48 to 1953-54*

Year	Number of mills	Cottonseed crushed
		Tons
1947-48	12	251,652
1948-49	13	320,060
1949-50[1]	13	315,861
1950-51[1]	13	270,166
1951-52	14	422,492
1952-53	13	435,150
1953-54	13	500,167

[1]Seed crushed for Commodity Credit Corporation on toll basis not included.

ORGANIZATIONAL SETUP

Cooperative cottonseed oil mills are regular businesses established according to law and having well-defined management and service functions.

Legal Setup

The 14 cooperative cottonseed oil mills are incorporated business organizations. They are cooperative corporations. Twelve are incorporated under their own State cooperative law while two are incorporated under the general corporation law. One is operated by a cooperative which has two co-equal departments, one marketing cotton, the other milling cottonseed. It is generally considered advisable for such associations to be incorporated under a cooperative statute. Such statutes contain provisions better adapted to the cooperative way of doing business than are usually found in general corporation laws. All States in which cooperative mills have been organized have cooperative statutes.

Articles of incorporation and bylaws drawn in conformity with State statutes are the basic legal documents and contain the rules and regulations by which each of these mills operates.

Another important document is the membership contract, or marketing agreement, which provides for delivery of all seed produced by members. Five cooperative mills have such contracts.

Cooperative cottonseed oil mills follow the fundamental principal in agricultural cooperatives of limiting payment for capital to a conservative rate. This limitation is recognized in both Federal and State laws. These laws merely place a ceiling on the amount which may be paid for invested capital. Cooperatives may pay any amount they choose up to the maximum. Most State statutes fix the limit at not to exceed 8 percent.

The Federal statute known as the Capper-Volstead Act, also recognizes the principal of limited returns on capital by setting a maximum interest rate of 8 percent if members vote on any basis other than one-man, one-vote. Cooperative cottonseed oil mills all comply with the Capper-Volstead Act in this respect.

Capital Structure

Cooperatives may be organized on a capital stock or a nonstock basis. Either method can be entirely satisfactory. The important point is that members furnish all the capital or enough capital so that any necessary borrowing can be on a sound basis. The means used to evidence the members' financial interest in an association is not of major importance. It may be capital stock, some kind of certificate, or other evidence of ownership.

For the most part, cooperative cottonseed oil mills have followed the capital stock plan. Twelve are organized with capital stock and two are on a nonstock basis. Eleven of the 12 mills organized with capital stock have provision for common stock and 10 have preferred stock. Nine of the 14 mills have provision for both common and preferred stock. One mill uses common stock only and one uses only preferred stock. Patrons' equity in one association is evidenced by common stock and general obligation bonds and in another by common stock, preferred stock and general obligation bonds.

For the 2 nonstock organizations, members' equity in 1 is evidenced by revolving fund certificates and in the other by patrons' equity certificates and allocated book credits.

In the case of the 10 strictly capital stock organizations, a certain portion of members' equity in the association may be evidenced by some form of certificate such as certificates of indebtedness, patronage equity certificates, preferred stock certificates and revolving fund certificates. For those 2 associations where bonds are involved, in addition to common and preferred stock and bonds, a certain part of patrons' equity may also be in the form of various kinds of allocated reserves and book credits.

Eight of the 11 mills with common stock limit to one the number of shares of such stock held by each member. Associations issuing preferred stock place no limit on the shares of such stock to be held by any one owner.

The par value placed on a share of stock has no significance from the standpoint of sound financing. The idea usually is to adjust the amount per share to the convenience and ability of members to invest in such stock.

Of the 11 mills with common stock, 6 place a par value of $100 a share on such stock; 1 of $50 a share, 1 of $25; 2 of $10; and 1 of $1. For 3 mills which have membership fees, the fee at 1 is $10 and at the others, $1 each.

As already indicated, 10 cooperative cottonseed oil mills have preferred stock. Par value of this stock for 6 associations is $1 a share. For 1 association, par value is $10 a share, for 2 it is $25, and for 1 it is $100.

Practices vary considerably with respect to dividends paid on capital stock. Four associations have no legal limit in their bylaws on dividends to be paid on common stock but must conform to State laws. The others pay from 4 to 8 percent. The limit placed on interest to be paid on preferred stock ranges from 4 to 8 percent.

Membership

Democratic control by members is a basic principle of agricultural cooperatives. Cottonseed oil mill cooperatives adhere strictly to this principle.

Bylaws of each association set forth qualifications for membership. Bylaws of some mills specify that only individual producers of cottonseed may become members while others provide for cooperatives only and still others provide for both individual producers and cooperatives. At most mills the prospective member, whether a farmer or a cooperative, must either purchase a share of common stock or pay a membership fee, which entitle him to voting rights, before he can become a member.

The cooperative mill and its co-equal marketing association, both members of the same overall cooperative, have many of the same growers as members. Individual farmers make up the entire membership in another mill. This form of organization is referred to as the centralized type of cooperative. Membership in eight of the mills consists entirely of cooperative cotton gins. This is known as a federated type of cooperative. The number of member gins for each of these associations is from 12 to 64.

Membership in four mills includes both individual farmers and cooperative gins (Figure 1). The number of farmers for these mills varies from 25 to 100 and the number of gins from 11 to 20. Some of these farmer members own and operate their own gin plants individually. On the basis of figures from each oil mill, total number of farmer patrons served by these mills, either directly or through member gins, is estimated at 50,000.

Voting and Control

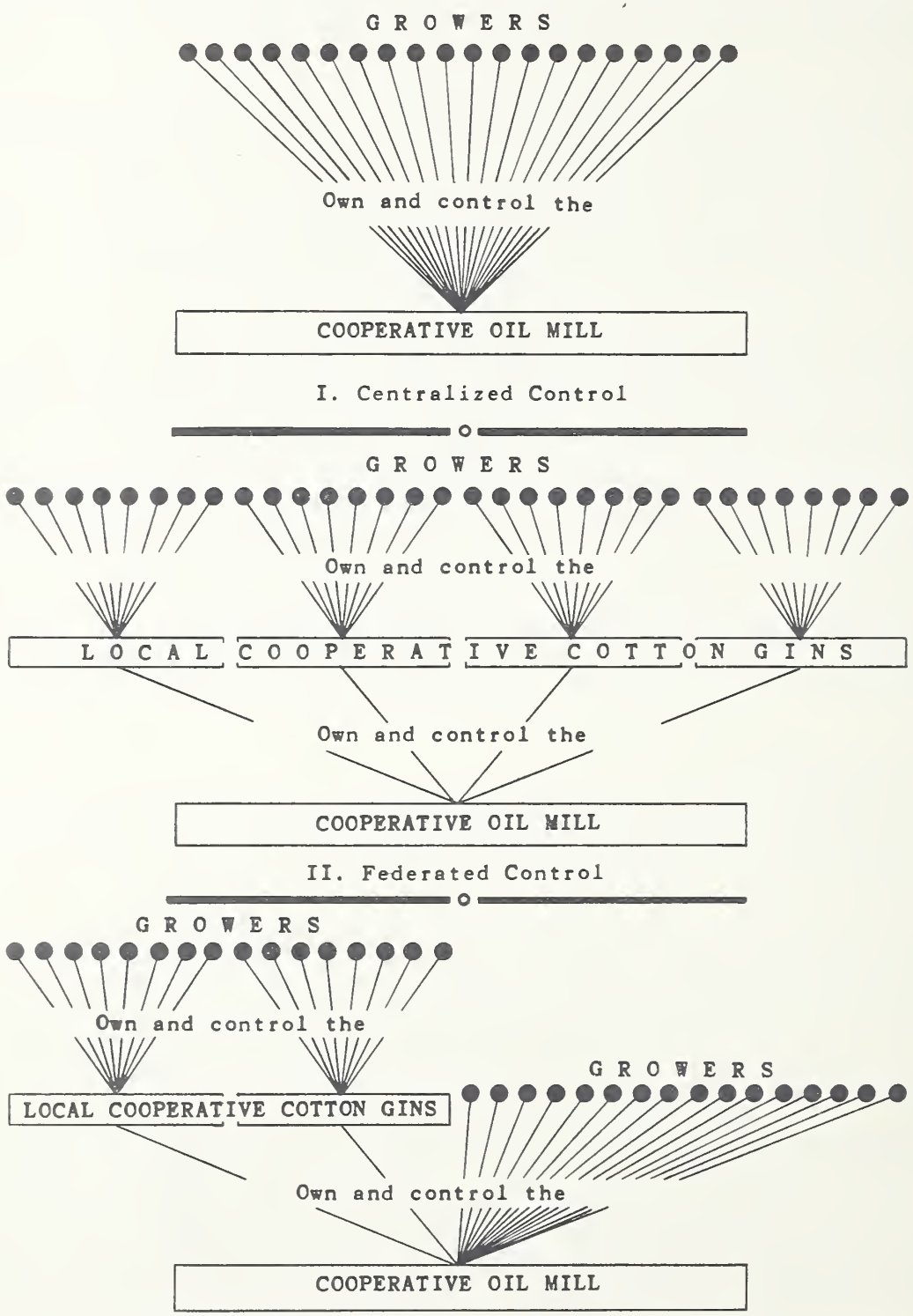
It is the practice in cooperatives to allow one vote to each member, whether a cooperative gin or an individual producer. Exceptions to the one-member, one-vote practice occur in two associations in electing directors. The State constitution under which one association is incorporated provides that each share of preferred stock carries one vote in electing directors. Another mill has a provision in its bylaws stating that "no holder of common stock shall have more than one vote except that in an election of directors each stockholder shall have as many votes as there are directors being elected and may distribute them among as many candidates as he shall see fit."[3] This is permissive under the cooperative marketing law of the State.

Because of differences in type of membership, methods of electing directors vary somewhat. The usual practice in electing directors for federated mills is for each member gin to select a representative to serve on the oil mill's board of directors. In some cases, these board members are selected by gin members at their annual meeting. In others, board members of the gin select a representative to serve on the oil

[3]Both associations limit dividends on stock to 8 percent or less.

Figure 1

OWNERSHIP AND CONTROL IN COOPERATIVE COTTONSEED OIL MILLS



III. Combination Centralized and Federated Control

mill's board. In one case, each member gin of the oil mill selects a delegate to the mill's annual meeting. These delegates select the mill's board of directors.

Where the membership is made up of both individual producers and cooperative gins, the usual practice is to elect directors at the annual meeting. With two exceptions, as already stated, these mills allow each member one vote in electing directors. If membership is in the name of the gin, the gin has one vote.

The centralized mills elect their directors at annual meetings of members. In many case, where a cooperative board has become too large the problem has been solved by selecting an executive committee to act for the board.

There is a question among some associations as to the best practice in selecting gin representatives. In some cases cooperative mill bylaws provide that directors elected to serve on the board of the mill shall be chosen from the boards of cooperative gins. In other associations boards may be composed of a combination of directors, farmer members and managers of cooperative gins.

The gin manager is usually the best informed person on the gin's detailed operations and often he knows more about oil mill operations than anyone else. On the other hand, unless he is also a producer of cotton and a member of a cooperative gin he is only an employee. In some cases, the question arises as to whether gin managers, as employees, should have a part in making policies for the business owned by producers. Where the gin manager does not represent the cooperative gin on the oil mill's board of directors, many gin associations have him attend the meeting with the director to give assistance on technical questions involving gin operation and its relation to the oil mill. This arrangement has worked out satisfactorily to all concerned.

Business affairs of the mills are under direction and control of a board of directors. The number on these boards ranges from 7 to more than 60. Without exception, association officers are elected by the board of directors immediately after the annual meeting.

Eight mills elect directors for only 1 year, while 6 mills elect them for 3 years. When directors serve for 3 years, it is the practice to stagger the terms so that part of them expire each year. The advantage in following this practice is that a majority of the board always is composed of experienced directors who are familiar with association policies and problems. There is no prohibition against re-electing a director to the board when his term expires.

Regular meetings of 10 of the boards are held monthly, and others meet every 2 months or quarterly. In some cases, provision is made for an executive committee to act in emergencies or in cases where frequent meetings of the board are not practicable. In other cases, the board

may appoint special committees to investigate and make recommendations on specific problems. A number of associations pay directors a small per diem for attendance at board meetings. It is also customary to pay a nominal rate per mile for going and coming to meetings although this is not universal.

Management

As stated previously, the governing and policy making body at the cooperative mills is the board of directors elected by the membership. This board in turn hires a manager to operate the mill in accordance with policies laid down by the board.

The manager hires other employees necessary to operate the mill and determines their salaries. In actual mill operation the key man is the general superintendent who reports directly to the manager. The superintendent is directly responsible for receiving, storing, and crushing the cottonseed furnished by members. In addition to the general superintendent, there is an assistant superintendent who handles the night or second and third shifts. Each major mill department, such as lint room, meal room, and press (extraction) room, has a foreman in charge for each shift operated. These foremen report to the superintendent in charge of the shift. Workers in each department report to the department foreman. Number of workers ranges from around 30 to over 100.

The office force is concerned primarily with the business end of the operation. Their main duties consist of selling products, buying seed and supplies, keeping records and payrolls, and making reports. In most instances they operate the scales. The office force is small compared to the mill force. The usual number is from 5 to 10 people which includes manager, assistant manager if any, bookkeepers, clerks, stenographers and weighers.

Functions

Techniques and methods of processing cottonseed are the same whether performed by a cooperative or by any other type of business organization. However, ownership and control of the business, its financial structure, method of allocating any savings made, and relations with members and patrons are all distinctive features of cooperative cottonseed oil mills.

Primary functions of a cooperative cottonseed oil mill are to crush seed for its members, market the products, and return net sales proceeds on a patronage basis. Inasmuch as a cooperative is owned and operated by its members, anything above cost belongs to them. It follows that service is of paramount importance.

Processing cottonseed and marketing the products involves performance of many services not directly connected with the crushing operation or marketing products, but of real benefit to cooperative members. Such services as buying seed f.o.b. gin and paying transportation charges, grading and analyzing seed and products, storing and financing huge quantities of seed, and assuming price risks are all necessary and important in marketing cottonseed.

Cottonseed trucks waiting to unload outside plant of Plains Cooperative Oil Mill, Lubbock, Tex.

OBTAINING COTTONSEED

Preliminary to the processing operation is obtaining seed. Cotton, as harvested and brought to the gin, consists primarily of two products -- cotton lint and cottonseed. The ginning process separates lint from seed. The proportion of lint and seed in any given quantity of seed cotton may vary considerably depending on variety of cotton and method of harvest.

According to the United States Department of Agriculture, producers of upland cotton during 1953-54 hauled to the gin an average of 1,367 pounds of handpicked seed cotton to obtain a 500-pound gross-weight bale. This compared with 1,347 pounds in 1952-53 and 1,371 pounds in 1951-52. On this basis, upland seed cotton contains around 1.6 pounds of seed and linters to each pound of lint cotton.

In recent years, mechanical harvesting of cotton has increased rapidly. Two important types of mechanical harvesters are the picker or spindle type, and the stripper. In harvesting with the spindle type, more dirt

and trash are brought to the gin in the seed cotton than in hand picking. The stripper harvests entire bolls, often including limbs to which bolls are attached. In such cases, the gin has to remove close to a minimum of 800 pounds of leaves, burrs, sticks, dirt and trash to make a standard 500-pound bale of lint and 800 pounds of seed. Toward the end of the season, it may take much more to make a bale of lint. Even in hand harvesting, it has become the custom in some areas to snap, which means pulling the entire boll.

The ginning process separates seed from lint and thereafter these two products, cotton and cottonseed, move through different marketing channels. We are concerned here only with marketing cottonseed and its products which consist of oil, meal, linters and hulls.

Seasonal Movement of Cottonseed

Movement of cottonseed to oil mills is seasonal. Seed cotton is usually moved from field to gin immediately after harvesting and ginners try to gin it as fast as received. This means a heavy movement of cottonseed into marketing channels during the cotton harvesting season.

With the exception of small amounts (around 12 percent of production) retained for seed and for direct feeding, the usual practice is for growers to sell their cottonseed to ginners at ginning time. Ginning charges are deducted from receipts of seed sales.

There is little or no farm storage of cottonseed. Although the length of time seed is held in storage at the gin is limited, most gins are equipped to store a small amount of seed -- usually not more than a day's production. As a rule, seed is held in storage at the gin only until a sufficient amount is accumulated for a shipment. Thus, gins do not store cottonseed as a major function.

A close relationship exists between the rate at which cotton is ginned and receipt of cottonseed at oil mills. Gins take little or no price risk in handling cottonseed since they do not hold it for any length of time. By operating in this way, most of the price risk in holding cottonseed is shifted to oil mills. In some cases, mills take the responsibility for price changes on cottonseed.

Receipts from Members

Practically all seed processed by cooperative cottonseed oil mills comes from members. Ten of the 13 associations reporting in 1952-53 received practically no seed from nonmembers, while the other 3 received from 10 to 40 percent, mostly from cooperative gins.[4] For all mills in 1952-53, only 2.5 percent of seed receipts came from nonmembers, chiefly cooperative gins.

[4]Operating data for 1952-53, latest year for which complete figures are available, included only 13 cooperative cottonseed oil mills.

For one reason or another, all members do not necessarily deliver all their seed to their cooperative mill each year. A member may feel obligated to deliver a certain amount of seed to another mill. For example, a cooperative gin may need an assured source of high grade planting seed and in order to obtain such seed will deliver an equal tonnage of crushing seed to another mill. In some instances, it has been necessary for management at the cooperative mill to ask members to dispose of part of their seed elsewhere because facilities at the mill were not adequate to take care of all members' seed.

The cost of obtaining seed is considerably less for a cooperative mill than a commercial mill. Members are owners of a cooperative mill and as a protection of their investment are under obligation to deliver most of their seed to it. For the most part, cooperative mills do not have seed buyers as do commercial mills.

Price Advance Policies

Practices differ on initial price advance made to patrons at the time they deliver their seed to the mill. Nine of the 14 associations advance their members the prevailing market price in the area at the time of seed delivery. In such cases, the initial payment is the same as the member would get if he sold his seed to any other buyer. Most associations that follow this practice do so because they feel it is necessary in order to obtain sufficient seed volume from members.

One association advances around 90 percent of the prevailing market price at time of delivery. The market price is set up, however, as credit on the mill's books. One association advances around 80 percent of current market price. The other three make a flat advance under the market of so many dollars a ton.

Associations that advance less than the market price have several advantages. In the first place, they are not in open price competition with other mills. No one knows what the final payment for seed will be at the season's end. This method also takes some of the risk of price fluctuation away from the association and places it on individual patrons for that delivery season, as it should be. Under such a program, each member is making a contribution to operating capital in proportion to his deliveries. An initial advance of less than the market price is sound cooperative practice.

Cooperative cottonseed oil mills are not pace setters from the price standpoint. Those that pay full market price at time of delivery follow the current price being paid in the area.

Cooperatives keep informed of prevailing prices paid by other mills in their territory. By telephone and telegraph, information on price changes readily becomes available to all mills concerned. If a cooperative mill is going to pay full market price for seed upon delivery, it is considered sound practice to follow prevailing prices rather than

to set the pace in its area. This keeps it away from price wars with its competitors and otherwise makes for more harmonious relationships.

SERVICES BEFORE PROCESSING

Certain services must be performed before cottonseed can be processed. The seed must be brought to the mill, weighed, graded, unloaded and stored.

Transportation

As previously stated, most cooperative cottonseed oil mills are in heavy cotton producing areas. This simplifies the transportation problem of getting the seed to the mill. Even so, considerable cross-hauling takes place. In other words because of special interest in certain gins, many mills go twice as far for seed as would be required to obtain the same amount of seed closest to them.[5] The same applies to cooperative mills since their member gins are scattered.

Cottonseed is bulky in relation to its weight. It takes almost 63 bushels to make a ton, which is about twice that of wheat. This bulkiness makes for relatively high cost of transportation. All mills are located on railroad sidings and either on main highways or have ready access to them.

Seed moves to the cooperative mills by both rail and truck. However, rail transportation is of minor importance. Eleven of the 14 mills receive seed exclusively by truck, while the other 3 receive from 80 to 90 percent by this method. In 1952-53, around 97 percent of receipts at cooperative mills were delivered by truck. Distance did not seem to be the determining factor as to method of transportation used. The distance the bulk of seed was brought in by truck ranged from around 25 to 120 miles. Maximum distance was 250 miles. The distance seed was brought in by rail was from 20 to 30 miles.

In some States commissions set up under State laws regulate rates charged for transporting cottonseed by truck. These commissions establish rates based primarily on ton-miles. In the absence of State regulation, rates are determined on the basis of distance, condition of roads, and competition. Included in the transportation charge is an allowance to the shipper for loading and handling seed.

Railroad cars usually carry around 30 tons of cottonseed. The amount of seed carried by truck varies widely. One common sized small truck known as the 5-ton bob-tail is used primarily for short hauls. Large trailer trucks bringing seed to the associations carry up to 20 tons. In all cases associations pay transportation costs of getting seed to the mill, a common practice for the industry. In many cases, the associations include freight as a part of the price paid for seed. Actually it isn't. The farmer would receive no part of the freight unless the gin realized a saving on freight allowance.

[5]U. S. Agricultural Marketing Service. Cooperative Economies of Different Types of Cottonseed Oil Mills and Their Effects on Oil Supplies, Prices, and Returns to Growers. 239 pp. Marketing Research Report No. 54. 1954.

ACCOUNT SALES–COTTONSEED

No. 3272 Coop Gin, Lubbock, Texas, 1-29 1954

We credit you with Seed delivered as follows:

Per DW 11499

Attached 1-3-

In Car Number

Gross: - - 75000 Lbs. Price $57.00 Ton, Basis Prime

Tare: - - - 42000 Lbs. Grade per Certif. Attached 101- %

Net: - - - 33000 Lbs.

LESS EXCESS Dirt and Bolls: No- Lbs. Adj. Price $57.57 Per Ton

or 16.50 Tons @ $57.57 Per Ton - - $949.90

Drayage - - - @ $2.70 Per Ton - - $44.55

Sub-Total - - $994.45

Less Stock-Retain: —

NET AMOUNT $994.45

PLAINS COOPERATIVE OIL MILL

Ext. O. K. By G

Each of the 14 mills sets up a schedule of transportation costs to each gin from which it receives seed. When the outturn (account sales) for seed is made to patrons, scheduled transportation costs are added to the amount due for seed. In other words, the mill pays a uniform basis price f.o.b. each gin.

Transportation charges paid by each mill vary considerably. In some cases, there is a difference of as much as $5 a ton. The rate per ton-mile decreases as distance increases, since handling charges are uniform. For example, the rate per ton at 1 cooperative mill to a gin 13 miles away was $2.20 while to a gin 120 miles away, it was $4.40.

The great bulk of seed coming to mills costs less than $3 a ton for transportation. Since the mill pays transportation costs, it means each patron bears the average cost regardless of distance. The practice appears sound from a cooperative standpoint. It is impossible for a mill to be located equidistant from each of its members.

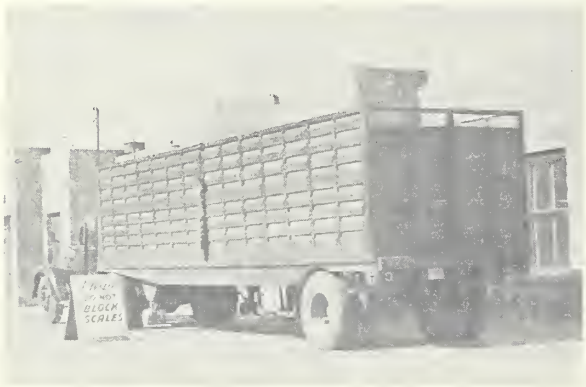
Only two mills own trucks for hauling seed. One association owns two trucks and the other five. Even these two mills must depend on gins or outside truckers to transport most of their seed. Seed transportation, therefore, is primarily a gin responsibility.

Associations urge truckers to keep the seed on trucks covered but are not successful in all cases. In some areas, the law requires that seed be kept covered while being transported. Covering seed protects it from weather, prevents waste, and may prevent spread of harmful insects and diseases.

Six mills have seed loaders varying in number from 1 to 25. These are portable loaders, loaned to the gins for loading cottonseed. For example, a member gin may have a truck break down during a heavy ginning period and get behind on seed hauling with the result that it becomes necessary to pile seed on the ground. These portable loaders can be borrowed and used to good advantage in loading such seed.

Weighing In Seed

Upon arrival at the oil mill, loaded trucks or cars are weighed. After unloading, trucks or cars are again weighed to obtain the net weight of the seed. Cottonseed as loaded into trucks or railroad cars is composed of various lots of seed recovered in ginning several bales of cotton. These individual lots of seed contain many different kinds and amounts of foreign matter as well as oil, protein, linters, and hulls.



Trucks are weighed when loaded with cottonseed and again after unloading.

Most seed is weighed in on scales that print the weight on a ticket. The same ticket is used when the truck is weighed out so that net weight can be easily calculated. A copy of this ticket is given to the truck driver to be returned to the association member who sent in the seed.

Seed Grading and Analysis

All mills grade cottonseed received by them. Grading of course, involves sampling. It is not easy to get a representative sample of a large truck or carload of seed. The United States Department of Agriculture has set up procedures to be followed in sampling cottonseed for grading purposes. These procedures are changed as conditions warrant.

Mill employees licensed by the U. S. Department of Agriculture for this purpose take seed samples. The Department prescribes sampling tools and procedures. Sampling methods specify approximately 2 pounds of cottonseed to be obtained for each ton in car or truck load.

From the combined or gross sample the amount of foreign matter is determined. After cleaning, a representative 2-pound sample is drawn from the composite sample and sent to a chemist licensed by the U. S. Department of Agriculture. These chemists issue official certificates of grade. It ordinarily takes 2 to 4 days to get the results on grading back from the laboratory.

Grading attempts to evaluate seed before milling by determining the extent of factors in seed which affect the quantity and quality of products to be obtained. These factors are percentage of oil, ammonia, moisture, foreign matter, linters, and free fatty acids. A combination of these items make up net quantity and quality index and grade. For information only, there is usually given the estimated yield of oil and 41 percent protein meal based on standard milling efficiency.

Mill employees licensed by the U. S. Department of Agriculture sample each load of cottonseed so that it can be graded.

Grading practices at cooperative mills differ due to custom and location. During the 1953-54 season, cooperative mills had nearly 13,000 samples of seed analyzed for an average of about 41 tons a sample. One mill had an average of 16 tons a sample while 2 mills had an average of more than 100 tons a sample. Other mills ranged from 21 to 80 tons. Solvent mills, as a group, sampled more often than hydraulic and screw press mills.

Grading cottonseed should work to the advantage of both seed processor and producer if the seed price is based on grade. When seed is graded, it is possible to pay a premium to producers of better quality seed and to discount poor quality seed. For example, if cottonseed is $60 a ton basis grade and a cooperative mill member sends in seed grading 110, he will be paid $66 a ton. If the seed grades 90, he will receive $54 a ton.

DATE RECEIVED August 6, 1953
SAMPLE MARKED Gin Run Seed 8-5-53

FOREIGN MATTER		ANALYSIS OF CLEAN SEED	
F. M. BY SAMPLER	%	OIL	18.4 %
F. M. BY LAB.	.1 %	AMMONIA	4.08 %
TOTAL F. M.	%	F. F. A. IN EXT'D OIL	.4 %
		MOISTURE	7.9 %

QUALITY INDEX DEDUCTIONS		GRADE CALCULATIONS	
Acct. Excess Foreign Matter		QUANTITY INDEX	103.08
Acct. Excess Moisture		QUALITY INDEX	100.0
Acct. Excess F. F. A.		GRADE	103.0
TOTAL			

FOLLOWING DATA EXTRA—NOT A PART OF THE STANDARD GRADES

ORIGINAL SEED		YIELDS	
LINT	10.4 %	ESTIMATED YIELDS BASED ON	
LINT	LBS.	STANDARD MILLING EFFICIENCY	
EXPECTED LOSS	LBS.	41.13% CAKE	969 LBS.
AVAILABLE LINT	LBS.	OIL	307 LBS.

REMARKS:
Official Methods of American Oil Chemist's Society Employed in this Analysis.
Respectfully submitted,

When mills do not grade or do not base the seed price on grade, all patrons receive the same price a ton regardless of quality. This practice can cause inequities between patrons. Recent studies have shown that there may be marked differences in the quality of cottonseed of the same variety grown within particular areas. This emphasizes the importance of

grading seed if patrons are to get payment according to the quality of seed produced in their areas. Buying on grade also affords the mill some protection in purchasing low-grade seed.

Gins do not grade seed they buy from growers. They usually pay a uniform price for seed with no differentiation for quality as between growers. However, since gins cover a much smaller area than oil mills, the difference in seed quality between growers in a gin area would not be as great as between growers in the entire mill area. Research is underway to develop a quick method for grading seed at the gin level.

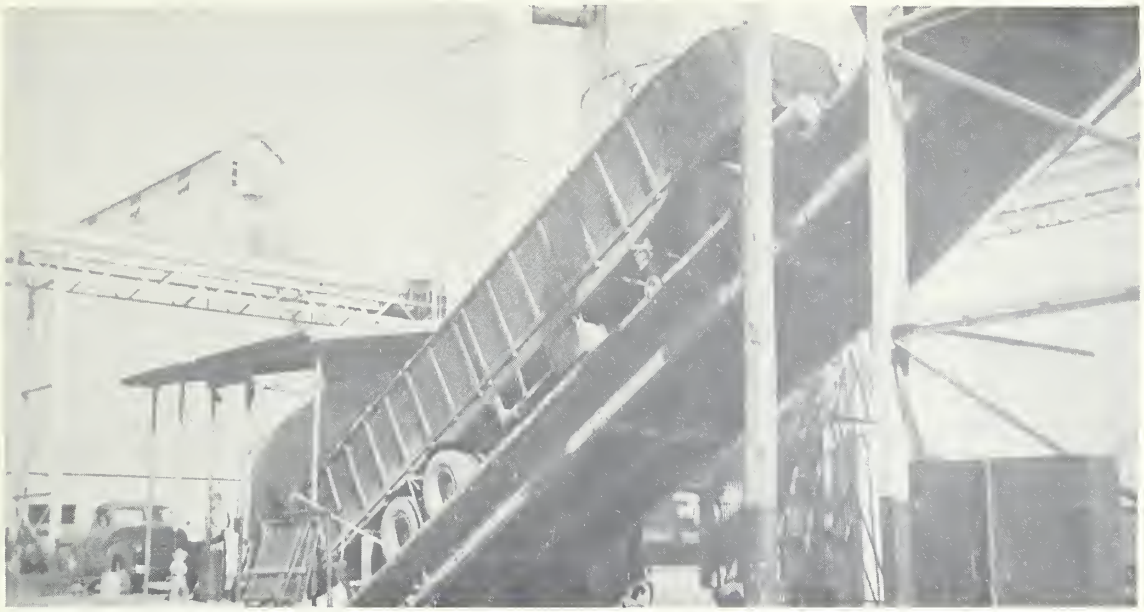
Seed Unloading

Because of the fast movement of cottonseed to oil mills during the heavy ginning season, provision must be made for rapid unloading of trucks and railroad cars. Otherwise the mills will have long lines of trucks waiting on their yards day and night to be unloaded. This idle time is expensive for both trucks and men. Also if trucks must wait too long for unloading, the seed may be taken elsewhere and the co-op mill will lose volume. To reduce waiting time for trucks as much as possible, cooperative mills have attempted to install enough unloading equipment to take care of seed about as fast as it comes in.

Three methods of unloading seed are used by cooperative mills. One is by pneumatic air unloaders. In this method, a large fan creates suction through a tube lowered over the seed. The suction pulls the seed up to a screw conveyor, or drops it into an incline drag conveyor, which in turn takes it to the sterilizer or direct to the seed house, if sterilization is unnecessary.

Some mills use air suction to unload cottonseed from trucks.

The second method is by dumping. A dump consists of a large pit with sloping sides lined with concrete located at one end of a platform. The truck load of seed is driven onto this platform. The front of the platform is lifted with the truck on it by hydraulic pressure or overhead cable. When the truck's tail gate is removed, the cottonseed slides out the back into the pit. Screw conveyors in the bottom of the pit move the seed to an incline drag conveyor. At the cooperative mill in California, cottonseed trucks are equipped with removable sides. They pass alongside a moving conveyor belt and unload from the side.



A semi-trailer dumps cottonseed into unloading pit.

The third method is the power shovel, a mechanically powered scoop that drags seed out of the truck after removal of the tail gate. The seed falls into a pit similar to that used in the dump.

Seven of the cooperative mills have from 2 to 6 pneumatic air unloaders each. Two mills have dumps only. Three mills have both dumps and air unloaders and one mill has pneumatic air and power shovel. Each pneumatic air unloader will handle from 400 to 1,000 tons a 24-hour day depending upon size of fan used. Up to 1,500 tons of seed can be unloaded by 1 dump in a 24-hour period depending upon size of the screw conveyor in the bottom of the pit. Largest tonnage unloaded by the mills in a 24-hour period in 1953-54 varied from 400 to 2,800 tons. This latter figure represents about 250 truck loads of seed.

Most of the mills have been able to unload seed about as fast as they arrive. Some have had short waiting periods due to mechanical failure or the simultaneous arrival of several truck loads of seed. It is practically impossible to entirely eliminate waiting for unloading. One mill arranges to pay for meals of truckers waiting in line at meal time. Another provides free coffee.

Sterilization of cottonseed because of pink bollworm infestation is required in many areas of the cotton belt. Sterilization slows up the rate at which seed can be unloaded. It also complicates the storage problem where steam is used for sterilization, since moisture and temperature must be reduced to a safe level before storage.

Sterilization is done immediately after unloading either with steam or heat, or with chemicals. Some cooperative cottonseed mills are equipped

Cottonseed poured into this dump is carried by bucket elevator to a nearby white seed (work) tank.

to sterilize cottonseed. However, most required sterilization is done at the gins. No cooperative mill was required to sterilize during the 1953-54 season.

Seed Storage

In contrast to gins, operation of oil mills requires that they hold considerable quantities of cottonseed at certain periods of the year. As already indicated, cottonseed moves to oil mills much faster than it can be processed during the cotton harvest. August, September, October, and November are the months of heaviest movement of cottonseed, although some mills receive seed each month. During heavy movement, mill stocks accumulate, usually reaching a peak in November and December. From around the first of the year to the end of the crushing season, crushings each month exceed receipts and stocks are gradually reduced.

Table 3 shows monthly distribution of receipts and crushings of cottonseed by cooperative mills for 1952 and 1953 crop years.

Table 3. - *Cooperative cottonseed oil mills: Distribution of receipts and crushings of cottonseed, by months, years ended July 31 1953, and 1954*

	1952-53		1953-54	
	Receipts	Crushings	Receipts	Crushings
Total in tons----	449,474	438,001	544,884	500,167
	Percent			
August----------	7.66	4.58	1.79	1.17
September--------	17.35	6.04	14.92	4.90
October----------	33.77	11.74	31.13	10.68
November---------	22.73	11.74	25.13	11.45
December---------	10.91	11.51	17.44	11.00
January----------	2.80	12.22	3.40	11.96
February---------	.65	11.23	.82	9.91
March------------	.26	9.37	.16	10.19
April------------	.27	8.13	.06	9.36
May--------------	.05	7.97	.15	7.78
June-------------	.43	4.87	1.40	6.91
July-------------	3.12	.60	3.60	4.69
Total-------	100.00	100.00	100.00	100.00

Seasonal movement of seed varies from area to area. For example, harvesting, ginning, and seed movement begin in June in the Lower Rio Grande Valley and end around the first of September. In the northern part of the cotton belt such operations do not begin until September or later.

The short harvesting and ginning season requires that large quantities of cottonseed be stored at mills during the period of heavy movement. If cottonseed oil mills were not willing to buy and store cottonseed, the price would be unduly depressed during this period. Holding large quantities of cottonseed requires large investments in storage facilities. It also means heavy financial requirements because money is tied up in seed stocks while awaiting processing and sale of products. Thus, it is evident that mills must assume considerable price risk in handling and processing cottonseed. Methods used by mills to reduce this price risk will be discussed under marketing risks beginning on page 63.

Since cottonseed is perishable, considerable care and attention must be given to proper storage for best results. Both moisture content and temperature are of prime importance. Moisture content of the seed, however, is the most vital factor in proper storage because high-moisture seed will heat and cause rapid quality deterioration.

Most of the mills believe seed can be safely stored if moisture content is not over 10 to 12 percent depending on the temperature. A close check of the seed analysis will show its moisture content and indicate whether or not it is likely to heat. During critical periods, temperatures may be recorded daily, two or three times a week, or weekly.

The mills differ in what they consider critical temperatures for cottonseed in storage. Some of them start conditioning seed when temperature approaches 80° F. Others consider seed safe up to 100°, depending on moisture content. They quite generally agree that temperatures of stored seed above 100° are not safe.

The usual practice in reducing temperature is to pull air through the seed with large fans usually about 60 inches in diameter. Some mills use cranes to stir and condition seed stored outside. By taking necessary precautions very little seed is lost because of deterioration in storage. Lack of proper precautions in checking stored seed has resulted in fires involving not only seed but also facility losses.

When a load of hot, wet seed arrives at a mill, it may not be placed in storage but instead blended with prime seed and milled immediately. In this way quality of products can be maintained, and damage to seed already in storage avoided.

In most areas, cottonseed must be stored in weatherproof buildings to prevent deterioration and spoilage. The modern type building for storing it has a steel frame covered with galvanized iron on sides and roof. The floor is concrete. The sides are vertical for about 12 feet

and the slope of the roof is 45 degrees, which is about the normal angle of repose for cottonseed. This is often referred to as the "A" type seed house.

In filling the house, incline drag conveyors elevate seed to the top of the house. Screw conveyors then carry seed across the top of the house and drop it through the center of the building. Such houses fill to the top because seed as it falls takes the same slope as the roof. A tunnel along the floor, the full length of the house, with tile laterals about every 8 feet makes it possible to pull air through the seed in case the temperature becomes too high.

These houses can be obtained in different sizes to meet storage capacity requirements. A rather common width is 90 to 120 feet and the length may vary from 100 to more than 300 feet. In general, the "A" type seed house will hold about 1 ton of cottonseed for each 2 square feet of floor space. However, the amount of seed that can be stored is affected by such factors as condition of seed, particularly lint content, and extent to which seed is packed.

This type house has a distinct advantage because it can be used as a general warehouse when not being used for cottonseed. A number of mills on occasion store linters, meal, or hulls in these buildings.

A few cooperatives use tanks or silos for seed storage. Most of these are steel. Seed is put into these tanks by blowing, by screw conveyors, or by bucket elevators. Silos in use by cooperatives range in size from 500 to 4,500 tons each. A number of older plants are using frame buildings of one kind or another for seed storage.

All the mills attempt to provide sufficient storage space to take care of normal seed receipts. However, several mills have stored seed outside when their closed storage was insufficient.[6]

If seed is piled on the ground, there is always the danger of spoilage, especially in areas of considerable rainfall. Such a practice has fewer hazards in West Texas or California than in East Texas or the Mississippi Valley. In East Texas and in California, the usual practice is to cover such seed with tarpaulins. In the more arid regions, seed may or may not be covered. Regardless of areas, there is considerable risk in storing seed outside without cover.

It is difficult to adjust the amount of storage needed for cottonseed to prospective mill deliveries. Seed receipts in any year will fluctuate depending on production in the area, number of patrons delivering, and climatic conditions during the harvest period.

This places a responsibility on directors for adopting the best policy to follow in providing storage. Should the mill have enough storage space to take care of heavy production years or just enough to take care of more or less normal production? If adequate storage is not

[6]The aerial view of Plains Cooperative Oil Mill, Lubbock, Tex., pictured on the front cover of this report shows piles of cottonseed in foreground and background.

available in any one year, the mill is faced with one or more of three alternatives -- either refuse to accept the seed, pile it outside on the ground, or sell it to some other mill.

All these procedures have definite drawbacks. If the mill refuses to accept seed, it may be turning down prospective patrons who may never again attempt to patronize it. Turning down volume which prevents the mill from operating at or near maximum capacity for the year keeps unit operating costs higher and savings for members lower.

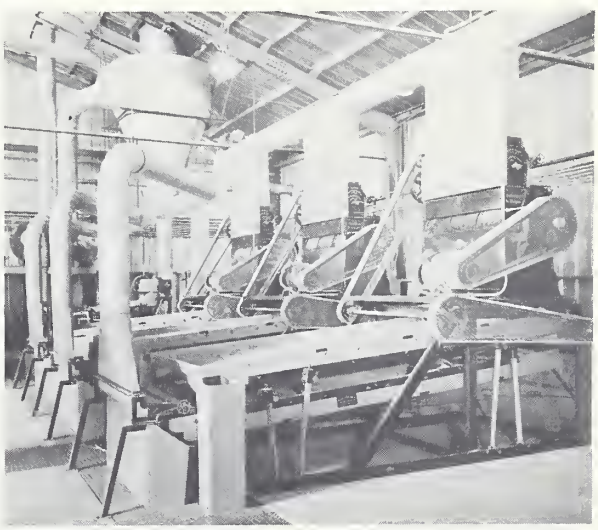
The more rapid movement of cotton to gins in the fall as a result of faster harvesting is also increasing the proportion of storage needed by the oil mill in relation to total crush. Estimates by mills of total amount of storage needed ranged from 60 to 80 percent of a normal crush.

It is not necessary to have storage for all the expected crush because seed is sent to the mill over a considerable period of time and the mill will be operating during that time. For example, a plant with 200 tons a day capacity should crush 5,500 tons a month or 16,500 tons in 3 months, which would cover most of the seed receiving season. If such a mill received 55,000 tons of seed, storage would be needed for only 38,500 tons, or 70 percent of expected receipts.

When cottonseed begins to move, mill managers are anxious to start crushing as soon as possible but not until they are sure they have enough seed to crush continuously. Most smaller mills try to accumulate around 500 tons of seed before starting to crush. One mill manager prefers to have 1,000 tons, another manager 2 day's run and another, 1 week's run.

PROCESSING COTTONSEED

As seed moves out of storage into the mill, it is beginning the long and devious journey through the various processing channels. It moves out of seed houses by screw or belt conveyors located in a tunnel in the center of the seed house. In more than half the mills, seed moves from storage directly into what are known as white seed tanks. These are large steel tanks for holding seed before it moves into processing channels. Tanks used by cooperative mills hold from 50 to 250 tons each, usually enough for 12 hours' operation. Use of these tanks insures an uninterrupted flow of seed into the mill for processing and also makes it possible to save labor in the storage house by stopping movement of seed out of storage during certain shifts.



Conveyors bring cottonseed from storage into this modern cleaning room where it flows through shaker screens that separate trash and other foreign materials.

Preparation for Extraction

Before oil can be extracted, the seed must be cleaned, delinted, and hulled.

Seed Cleaning

Cottonseed moves either from the white seed tanks or directly from seed houses into the cleaning room. It must be cleaned because it usually contains considerable trash such as leaves, twigs, rocks, sand, cotton burrs, wire and other foreign material. This foreign matter causes undue wear and tear on machinery, discolors lint, and reduces the quality of oil and meal.

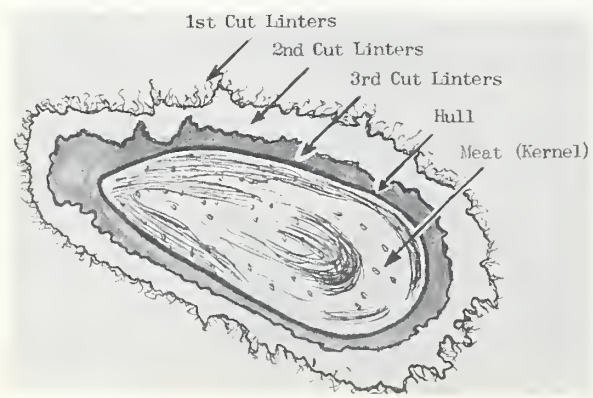
Types of equipment used for cleaning cottonseed are much the same for all mills. One or both of two types of machines are used, the revolving screen and the shaker screen. Mill superintendents modify machinery and change the process to suit their own conditions.

The revolving screen is more commonly known as the boll reel. It is an inclined revolving, cylindrical reel with perforations large enough to allow seed to fall through. Another small screen permits sand to fall through. Small pieces of foreign matter also go through but larger ones are discharged from the lower end of the reel.

Most common type of seed cleaner is the shaker screen. It consists of a perforated metal platform set on an incline. Its shaking motion causes seed to move down and foreign matter passes through the perforations. Screens are frequently supplemented by blowing or by suction fans. Perforated conveyors may be used to remove foreign material, particularly sand. Magnets are used in many places throughout the mill to remove any metal that could cause fire or damage to machinery.

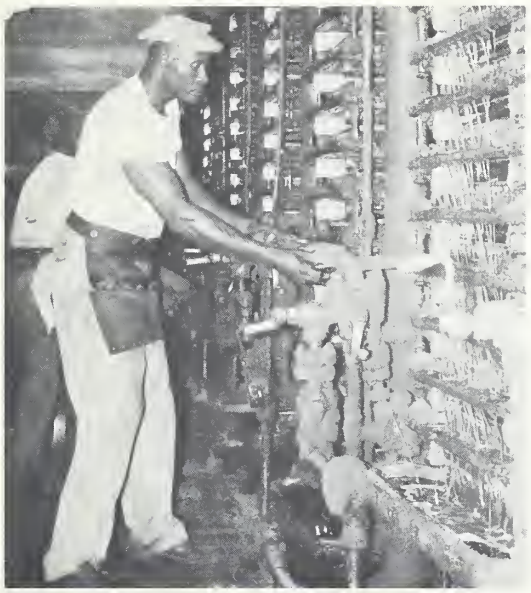
Delinting

Each cottonseed has three principal parts: linters, hull, and meat - the latter containing the oil and meal. After cleaning, the next step in processing is delinting. Upland cottonseed as it leaves the gin is covered with short fuzzy fibers which have not been removed in ginning. These fibers may make up from 8 to 20 percent of the total weight. They are removed by machines known as delinters and the product removed is known as "cotton linters."

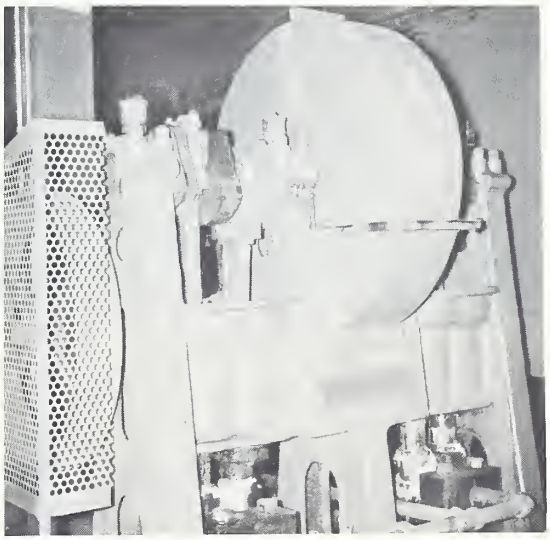


Cross section of a cottonseed showing linters, hull, and meat.

Delinters are built in separate units called "stands" closely resembling stands found in cotton gins. Principal difference is the number of saws per stand. In

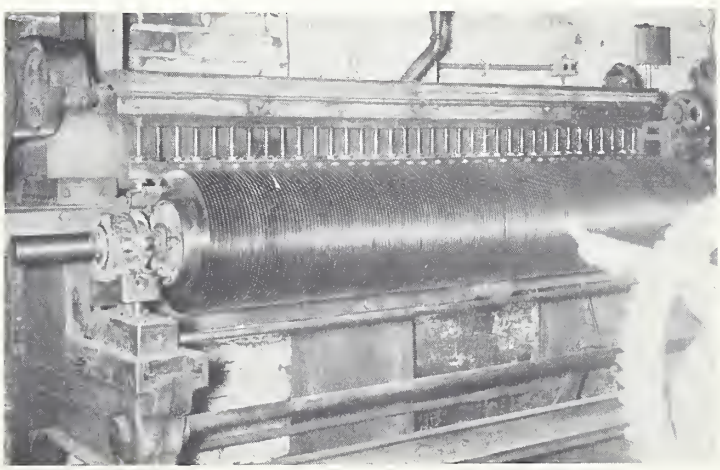


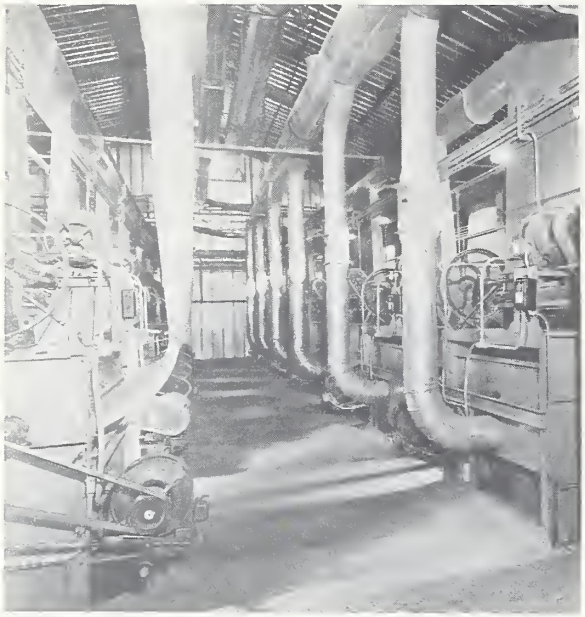
Left, a cooperative mill employee charges a hydraulic press, which consists of a series of rectangular steel boxes, one above the other. Cakes are placed in these boxes, and pressure exerted on them squeezes out the oil which can be seen running out of the press on the right.



Above, baled linters loaded into railroad car for shipment to manufacturing plants for conversion to cellulose. End use may be rayon, gunpowder, sausage casings, or plastics.

Above, hammer mill that grinds cake or flakes into meal which is sold directly to feed mixers and livestock feeders or is made into pellets. Right, an automatic linter sawfiling machine. Linter saws like the one shown here are used in all mills and must be kept sharp. This filing machine does a much better job than was formerly done by hand.





In linter rooms such as this are stands containing saws that cut linters from cottonseed.

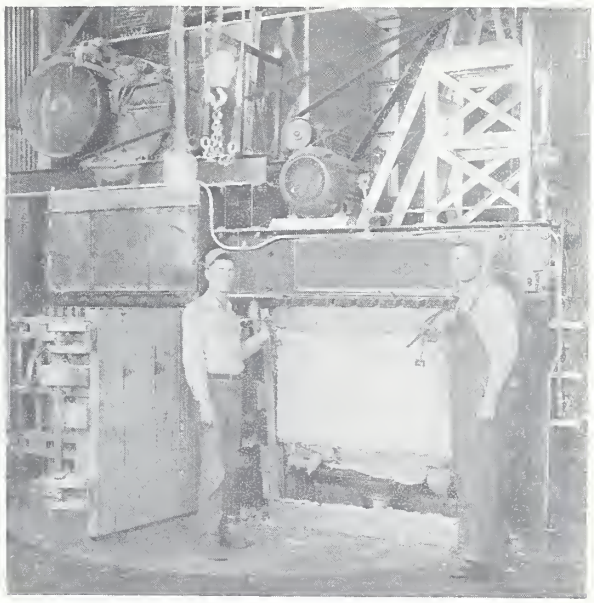
a cotton gin the number of saws per stand ranges from 70 to 90 with most gins having 80. In oil mills, the number of saws per stand ranges from 106 to 176 with most mills having 141 or 176. Of the 419 linter stands in cooperative mills in 1953-54, 281 had 176 saws each, 90 had 141 saws, and 48 had 106 saws. Usual practice in oil mills is to sharpen saws once every 24 hours on automatic saw filing machines.

Each stand has a roller with a series of circular saws projecting through a set of steel ribs. As seed falls on the ribs the saws revolve, cutting short fibers and carrying them through the ribs. Individual seeds are too large to pass through the ribs. In some cases, fibers are removed from saws by a cylindrical brush revolving with the saws but at a somewhat higher speed. In other cases fibers are removed by an air pick-up system. Usual practice is to run seed through a part of these machines to produce what are known as "first cut" linters and through the remaining machines to produce the "second cut." A new practice among some mills is to make a "third cut" or even more. Three cooperative mills are equipped to make four cuts if desired.

First cut linters consist of the longer fibers on seed and additional cuts consist of shorter fibers. Existing market demands and prices for various grades of linters influence the quantity of linters produced by each cut. Generally speaking, the proportion of lint by weight on upland cottonseed as it comes to the oil mill is from 10 to 12 percent. After delinting, the weight of lint left on seed is around 2 percent. However, the price of linters can have an effect on the quantity of residual lint. In any case, all lint is never removed.

Linter capacity ranges from 4 to 8 tons of seed per day per stand, with an average of around 5 tons, depending on amount of lint on seed, amount of lint removed, and number of saws. Those mills that make first and second cuts usually have from one-fourth to one-third of their linter machines on first cut and from two-thirds to three-fourths on second cut. This means, for example, that a mill with 32 linter machines processing 150 tons of seed a day would run the 150 tons through 8 machines to remove the first cut linters and through 24 machines to remove the second cut linters. During the 1953-54 season, 13 cooperative mills had 419 linter stands - 119 on first cut, 258 on second cut, and 42 on third cut.

Cooperative mills have from 16 to 82 stands each for delinting cottonseed depending on crushing capacity and amount of linters on seed. For cooperative mills, throughput per stand per day in 1952-53 ranged from 4.1 to 7.3 tons and averaged 5.4 tons.



This is a linter bale press in which linters are baled and then shipped or stored.

Linters are taken by air from linter machines through lint beaters and cleaners to the bale press where they are compressed, wrapped, and tied into bales weighing around 600 pounds, ready for storage or shipment. Nine mills have two bale presses. Four have only one each; these are usually double box presses, however. Motes, the heavier particles in the linters, are drawn off as linters leave the brushes and are picked up by the lint flue system, or they fall into a conveyor. Motes are also baled and sold in the same manner as linters. A common practice is to use one bale press for first cuts and motes and the other one for second cuts.

Hulling

After delinting the next step is to remove hulls which surround kernels or meats of seed. Five cooperative mills convey seed from linter room directly to huller room, but eight mills move seed into larger storage tanks known as black seed tanks. Some mills delint seed faster than it can be processed. By storing seed in a black seed tank, it is possible to close the linter room certain shifts or days and make substantial savings in labor costs. Use of the white and the black seed tanks is almost essential for continuous crushing operations since they can be used as supply or storage space in case of mechanical failure in any part of the mill.

Seed moves from storage tanks directly to huller or separation room. In the huller room seed pass through a machine known as a bar huller containing a series of knives that cut the hulls and loosen them from cottonseed kernels or meats. This mass then moves through a series of beaters, shakers, and separators which separate the loosened hulls from the meats. The hulls then move into storage or directly into railroad cars for shipment. The meats are ready to be prepared for the extraction process.

Methods of Extraction

In the United States, three principal methods or processes are now in use for extracting oil from cottonseed. These are used by all mills, cooperatives and others. The oldest of these is the hydraulic process. This has been the predominant method in use since the beginning of cottonseed crushing. Screw presses came into usé about 1900 and since that time have increased rather rapidly. A more recent method of extraction is the chemical or solvent process. Some mills now are using a combination of screw presses and solvent extraction - called pre-press solvent extraction. Latest development is a modification of solvent extraction known as filtration extraction. It should be pointed out in the discussion of the various methods of extraction that no one method excels all others in every phase of operation.

Before 1900, hydraulic processing was the only method used to crush cottonseed. Even in 1927, 96 percent of all active mills were hydraulic. The number of hydraulic mills has declined rather rapidly since that time to 93 percent of the total in 1937, to 81 percent in 1948, and to 68 percent in 1952. Screw press plants made up about 4 percent of the mills in 1927, 7 percent in 1937, 21 percent in 1948, and 27 percent in 1952. Solvent plants came into use in the late 1940's and comprised less than 2 percent of the mills in 1948 and about 6 percent in 1953.[7]

Bureau of the Census information indicates relative importance of different extraction methods from a total volume standpoint. During the 1952-53 season, 5.5 million tons of cottonseed were processed. Of this total around 46 percent, or 2.5 million tons, was crushed by the hydraulic method; 1.8 million tons, or 33 percent, by the screw press method; around 512,000 tons, or 9 percent, by the solvent extraction method; and 639,000 tons, or 12 percent, by the pre-press solvent extraction method. (Table 4.) The proportion of seed crushed by solvent extraction was increasing rapidly. For the preceding year, 1951-52, less than 12 percent of the seed was crushed in solvent and pre-press solvent plants.

Solvent mills, pre-press solvent in particular, crush much larger tonnages per mill than do the mechanical type mills. During the 1952-53 season, hydraulic mills averaged around 12,000 tons, screw press mills 22,500 tons, solvent mills 51,000 tons, and pre-press solvent mills almost 80,000 tons.

Methods of extraction used by cooperative mills have changed rapidly in recent years. In the 1945-46 season, 13 cooperative mills were in operation. Twelve were hydraulic and one was screw press. These same 13 mills were operating in the 1950-51 season, but only 3 of them were still using hydraulic presses, 3 had converted to solvent extraction,

[7]Raskopf, B. D. Marketing Practices, Facilities, and Processes of Cotton Oil Mills in Tennessee and the United States. 46 pp. Agricultural Experiment Station, University of Tennessee. 1949.

Agricultural Marketing Service. Processing the Three Major Oilseeds, Marketing Research Report No. 58. 37 pp. 1954.

Table 4. - *Cottonseed processed by different methods, United States, 1952-53 season*[1]

Type of equipment	Number of mills[2]	Tons processed		Percent of total
		Total	Average	
Hydraulic----------	205	2,509,280	12,240	46.0
Screw press----------	80	1,798,366	22,480	32.9
Solvent----------	10	512,439	51,244	9.4
Press-press solvent---	8	638,915	79,964	11.7
Total[3]----------	303	5,459,000	18,017	100.0

[1]August 1, 1952 - July 31, 1953.
[2]Mills using more than one type of extraction process classified according to their major type of process.
[3]Does not include eight mills which delint and ship the cottonseed meats to a central solvent extraction plant where the oil and meal are produced..

Source: Bureau of the Census, U. S. Department of Commerce.

and 7 were using screw presses. Two of the three solvent mills were pre-pressing. During the 1952-53 season, 14 cooperative mills were in operation. Only 2 were using hydraulic presses and 1 of these has since gone over to screw presses. There were 4 solvent mills - 2 on straight extraction and 2 were pre-pressing. The remaining 8 mills were using screw presses.

The first cottonseed oil mill in the United States to use the solvent process, Delta Products Company, Wilson, Ark., a farmer cooperative, started solvent crushing March 1947. Within the following year, two other farmer cooperatives built solvent extraction plants. These were the Helena (Ark.) Cotton Oil Company, and Osceola (Ark.) Products Company. Later Delta Products added screw presses and became the first pre-press solvent extraction plant for cottonseed in the United States.

Combined daily crushing capacity of cooperative mills at the end of the 1952-53 season was approximately 2,100 tons of cottonseed. Solvent mills had a total of around 1,000 tons daily capacity, screw press 900 tons, and hydraulic 200 tons. Daily capacity per mill ranged from around 80 to 400 tons. Cooperative mills have led the way and are far ahead of the industry in modernizing crushing equipment.

Hydraulic Processing

Meats after being separated from hulls are first passed over heavy steel rollers which flatten them into thin flakes to expose the greatest number of oil bearing cells. Flakes usually have a thickness of between 5 and 10 one-thousandths of an inch. They are fed into steam jacketed cookers. The cookers generally used today are of the 4- or 5-high stack variety, that is 4 or 5 kettles placed one above the other. Individual

kettles in the cookers are usually 7 or 8 feet in diameter and about 28 inches high. By control of steam pressures, temperature in the top kettle is maintained at around 120° F. and in the bottom kettle at around 240° F. Cooking time is usually about 90 minutes. Rotating scrapers stir the flakes to insure uniform temperature and moisture.

From the cooker, measured quantities of meats are wrapped in press cloth and pressed slightly in the cake former to form a cake which can be conveniently handled and is of proper size for the press box or cage. The hydraulic press consists of a series of rectangular steel boxes, one above the other, each of which is perforated on the bottom. When cakes are placed in the boxes, pressure on them is gradually increased, through the medium of a hydraulic ram, to around 4,000 to 5,000 pounds per square inch to squeeze the oil from the flakes. This pressure is maintained for varying periods of time, depending on mill policy, but usually around 30 to 45 minutes.

After the pressure is released, the cake is removed from the cage and the press cloth stripped off by a cake stripper. Edges of the cake usually contain much of the remaining oil. The slab cake is then run through a trimmer. These oil-rich trimmings then re-enter the flow of meats for further extraction. One hydraulic press has a capacity of about 10 tons of cottonseed for 25 hours, but may vary from 8 to 14 tons, and produces a cake containing around 5 or 6 percent oil.

Only two cooperative mills were using hydraulic presses in the 1952-53 crushing season. They had a total of 22 presses with 12 to 15 boxes a press. They used a pressure of around 5,000 pounds a square inch and a drainage time of 25 to 30 minutes and produced a finished cake weighing 15 to 20 pounds. They used a temperature of 120° F. to 240° F. in the cookers and cooked for about 90 minutes. Residual oil in the cake averaged slightly over 5 percent.

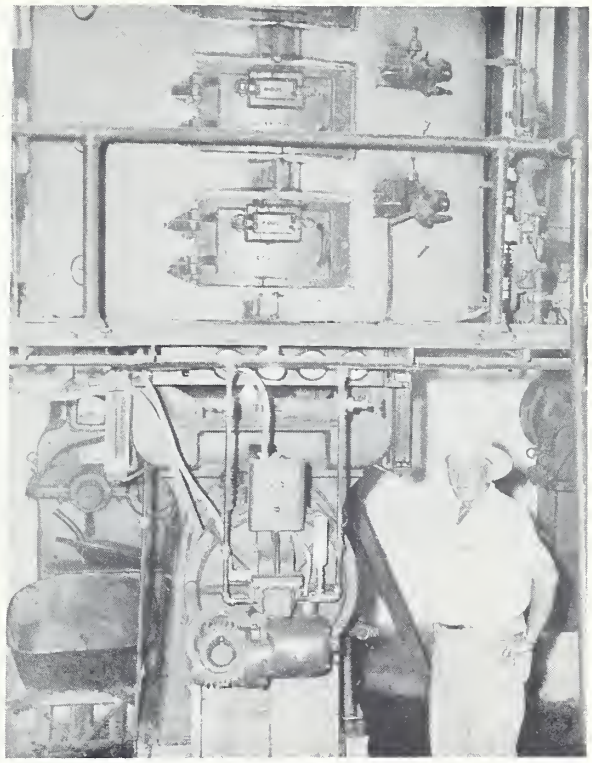
Screw Pressing

During the past few years screw presses have been rapidly replacing hydraulic presses. Probably the most important reasons for the conversion are saving of labor in the press room, increased oil yield, and no cost for press cloth. Principal disadvantages might be listed as higher initial cost, repair costs, and power consumption.

The expeller press is somewhat on the order of a large meat grinder. The heated, conditioned meats pass into one end of the press. Pressure up to 10 to 12 tons a square inch created by a revolving screw inside a steel cylinder forces out the oil. Another feature is that each screw press usually has its own individual cooker attached for conditioning meats for extraction. This cooker is not so large as the one described under hydraulic extraction. Temperatures maintained in the cooker for screw press mills probably should not exceed 240° F. and there is evidence that cooking at lower temperatures produces meal with higher digestibility.

A modern screw press has capacity of 25 to 30 tons of cottonseed for 24 hours. A recent development in the industry indicates that this capacity may be increased to as much as 50 tons by speeding up the machine and increasing the cooking and conditioning capacity.

Good screw press operations should reduce the oil content of the cake to around 4 to 4.5 percent, thus yielding 10 to 20 pounds of additional oil per ton of seed when compared to hydraulic pressing.



The screw press used by more than half of all cooperative cottonseed oil mills has its own cooker attached above to heat and condition meats for extraction of oil.

In 1952-53, the 8 cooperative cottonseed oil mills using the screw press method of extraction had 31 presses with from 3 to 6 presses a mill. For the most part, these mills used a 4- or 5-high cooker and maintained a temperature range from 190° F. to 260° F. Cooking time ranged from about 20 minutes to as much as an hour with an average of around 35 to 40 minutes. All mills flaked or rolled meats before cooking them. Most of the mills crushed at a rate of 30 tons per 24 hours a press with the low mill reporting 25 tons and the high mill 33 tons. Residual fat in the meal ranged from 4 to 4.9 percent with an average of 4.4.

After extraction, either by hydraulic or screw press process, the oil flows into the sludge or settling tank where the fine particles of meal, called foots, are removed and returned to the flow of meats. Oil is then pumped through the filter press, if necessary, and to storage tanks or directly into tank cars for shipment as crude oil.

Solvent Extraction

Basically, solvent extraction is a simple process. It merely means mixing an oil bearing material with a suitable solvent which dissolves out the oil and carries it off just as cleaning fluid removes grease spots from clothes in a dry cleaning plant.

All the processing steps for cottonseed through the hulling operation are the same regardless of the method of extraction. The solvent extraction plant, which serves the same purpose as the press room in mechanical or pressure plants, is much more elaborate and complicated.

A cooperative cottonseed oil mill's solvent extraction plant and refinery with storage tanks.

Such factors as temperature, moisture, and flaking must be more closely controlled in solvent extraction than in pressing if a satisfactory extraction job is to be performed.

The two principal kinds of extractors used in the cottonseed industry are known as immersion type and basket type. In either case, proper preparation and conditioning of meats is necessary. In straight extraction (not pre-press solvent extraction) this is accomplished by taking the meats from the meats surge bin through the cracking rolls to the conditioner, or cooker, where desired temperature and moisture are attained, and then to the flaking rolls where flakes of desired thickness are made. Object of this preparation is to break down the structure of seed so that the solvent has the greatest access to the oil it must remove.

Immersion Type Extractor - The conditioned flakes are carried from flaking rolls to the top of the extractor. The extractor column contains a series of perforated horizontal plates. Rotating scrapers stir the flakes and push them through the perforations. The solvent, hexane for the most part, is pumped in from the bottom of the extractor, moves upward against the falling flakes and dissolves out the oil. Thus, the fresh solvent comes into contact with the low oil content flakes at the bottom of the extractor. The mixture of solvent and oil, known as miscella, overflows the top of the extractor column and goes through a series of centrifuges, heaters, filters, evaporators and condensers which remove all traces of solvent. The oil when cooled is ready for storage or shipment. The reclaimed solvent is returned to storage.

The extracted flakes are drawn off from the bottom of the extractor and elevated above the solvent level, where much of the solvent drains out

of them. Final traces of solvent are drawn off in a series of driers, condensed and returned to storage. The solvent free meal (spent flakes) then goes through the meal toaster, cooler, sifters and grinders to the sacking equipment or storage.

Basket Type Extractor - Steps for preparation of flakes for this extractor are virtually the same as for the immersion type. Conditioned flakes are carried to the filling column on top of the extractor. This type of extractor has a series of baskets on an endless chain. These baskets have perforations in the bottom for the escape of solvent and oil. The baskets, filled with conditioned flakes and miscella at the top of the extractor, move down the side. The miscella filters through the flakes and into the basket below.

At the bottom, the baskets make the turn and start up the opposite side of the extractor. During this upward trip, fresh solvent is continuously injected near the top of the extractor to remove the final oil. The baskets dump the spent flakes at the top of the extractor and are immediately re-loaded. As in the case of immersion extraction, the spent flakes go through the process of solvent removal, toasting, cooking, moisture adjustment, screening and grinding to the sacking equipment or bulk storage.

In the basket extractor, miscella is drawn off from the bottom of the extractor, the solvent removed, and the oil cooled and moved to storage in much the same kind of equipment as that used in the immersion type plants.

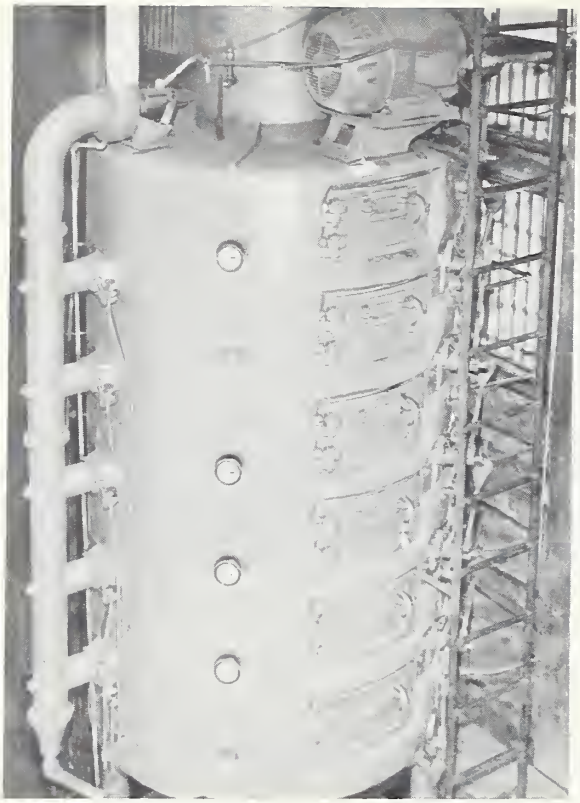
Pre-Press Solvent Extraction

A new development in the solvent extraction field is the use of screw presses in conjunction with, and ahead of, the solvent unit -- hence the term pre-press. The process is used with either immersion or basket type systems.

In pre-pressing, meats are prepared for extraction in the same manner as described for screw presses. Presses are speeded up on the same order as the high capacity screw presses, and much more material is run through them. The objective is to reduce oil content of the press cake to around 10 to 14 percent. Oil obtained in the pressing operation is handled the same as the oil from the screw press described previously.

The screw press cake is run through a cake breaker or granulater, a conditioner for heat and moisture adjustment, then through the flaking rolls and to the extractor. These flakes are tougher and more easily handled than the ones in straight extraction. They move through the extractor in the same way and desolventizing of the products is the same as in straight extraction. Since the meats were cooked in the screw pressing process, it is not necessary to toast the meal. This meal will contain less residual oil than straight extracted meal.

Three of the 4 solvent mills in 1952-53 were of the immersion type and the other 1, the basket type. Two of the immersion plants were pre-pressing, and the other 2 were on straight extraction. Three of these



Temperature is important in a solvent mill. Cottonseed meats are kept in a cooker like this for 20 minutes at a maximum temperature of 175° F.

plants had a daily crushing capacity around 200 tons each and the other, 400 tons. Solvent machinery in all these plants is located in a separate concrete and steel building. Two mills have their preparation equipment in the same building but separated by a fire wall from solvent equipment. Preparation equipment for the other two plants is located in the mill building.

The pre-press plants cook the meats at a temperature range of 200° F. to 240° F. for 45 to 60 minutes before extraction, while the other plants cook at a maximum of 175° F. for 20 minutes. All these mills use hexane as the solvent and report a solvent loss of 2 to 3 gallons per ton of seed processed.

Although the two pre-press mills do not toast the meal after extraction, the other 2 solvents toast at temperatures of 200° F. to 250° F. for 20 to 25 minutes. The pre-press mills leave 1 percent fat or less in the meal and the other 2 solvent mills leave 1½ to 2½ percent.

PRODUCING, UTILIZING AND MARKETING COTTONSEED PRODUCTS

Cottonseed derives its value from its four products, oil, meal or cake, hulls, and linters - all with widely different uses and values. Each moves through different channels of trade and presents its own problems in handling and marketing.

In the long run, the total amount an oil mill receives for its products determines the price the mill can pay for seed. Knowing the prices which can be received for each product and probable yield of each from a ton of cottonseed, the manager of a mill can compute the gross value of a ton of seed in terms of products. From this gross value must be subtracted estimated transportation and conversion costs and desired margin per ton crushed. Theoretically, the resulting figure will be the price a mill can pay for seed, but in actual practice, the price may be above or below the amount arrived at by this method. Local price competition often forces the price of seed upward and out of line with product values for temporary periods. For one reason or another, some

mills have certain competitive advantages or disadvantages which influence the amount they pay for cottonseed.

Table 5 shows the average amount of each product obtained from a ton of cottonseed for 6 years, 1948-53, for all mills and for cooperative mills.

Table 5. - *Cottonseed products: Average number of pounds obtained per ton of seed crushed, United States, 6-year average, 1948-49 to 1953-54*

Product	All mills[1]		Cooperative mills	
	Pounds	Percent of total weight	Pounds	Percent of total weight
Crude oil	325	16.3	345	17.3
Cake and meal	922	46.1	929	46.5
Hulls	453	22.6	462	23.1
Linters	182	9.1	179	8.9
Manufacturing loss	118	5.9	85	4.2
Total	2,000	100.0	2,000	100.0

[1]U. S. Bureau of the Census, Bulletins 189 and 191.

The higher oil yields by cooperative mills may be due in part to location but at least some of the higher yields can be attributed to more efficient extraction because of better than average crushing equipment.

Crude Oil

Although the oil obtained from cottonseed makes up less than 20 percent of the weight of seed, its value is about 50 percent of total product value. Since it is the most valuable of the four products, it receives major attention in the cottonseed processing industry.

Cottonseed oil is used primarily in edible products with small amounts going into inedible products. Before being used as food, the crude oil as it comes from the mill must be refined.

For the 5 years, 1948-52, around 91 percent of the cottonseed oil produced in the United States was used in food products. About 30 percent was used in shortening, 28 percent in margarine, and 33 percent in other food products, mostly cooking and salad oils and for direct use in bakeries and institutions.

Non-food uses accounted for 9 percent -- mostly soap, paint and varnish, printing inks, and linoleum. For the most part, only off-grade oil and the residue remaining from the refining process were used in nonedible products.

Cottonseed shows considerable variation in oil content. This can be accounted for largely by climate, soil and variety grown. The oil content of cottonseed will usually range from 16 to 20 percent by weight with an average around 18.5 percent. Different extraction processes also affect recovery of oil from the seed. Average outturn of oil per ton of seed changes considerably from season to season and from area to area, but the general trend has been slightly upward.

Table 5 showed the outturn at cooperative mills was somewhat higher than for all mills. There is a wide range in the oil outturn among the cooperative mills. For example, in 1953-54, the range in oil produced was from 296 pounds to 382 pounds at two of the mills. Both these mills were located in the same State and were using the same method of extraction.

Estimated amount of unrecovered oil remaining in the cake or meal varies directly with the ammonia content. Using hydraulic standard and 41 percent protein or 8 percent ammonia meal, it varies from 50 pounds in seed with 2.8 percent ammonia to 65 pounds in seed with 4.8 percent ammonia.[8] There may also be differences in extraction efficiency by mills of the same type, processing the same kind of seed. The technical skill with which each processing step is carried out no doubt accounts for most if not all of this difference.

Crude oil is perishable and storage for any length of time may result in quality deterioration. For this reason, mills try to ship the oil about as fast as it is produced. Another reason for selling oil as fast as possible is to minimize the risk of price declines. Since cottonseed crushing is seasonal, production of crude cottonseed oil is also seasonal.

[8]Rules of National Cottonseed Products Association, Memphis, Tenn.

The cooperative cottonseed oil mill stores its most valuable product, oil, in tanks like these.

Heaviest production is during the 6 months, September through February. As a result, refiners assume the responsibility for storing and financing a large part of the cottonseed oil supply for several months each year, since consumption of refined oil is rather uniform throughout the 12 months.

All cooperative mills have enough storage capacity for oil to take care of at least several days' run. None of them has had to shut down its plant because of lack of storage space. Total oil storage capacity for cooperative mills early in 1954 was 203 tank cars (60,000 pounds a car) with a range of from 4 to 57 cars a mill.

Two cooperative mills are now equipped to refine crude oil. One of these mills operates its refinery only when a satisfactory outlet cannot be obtained for crude oil. The other mill, which installed its refinery during the 1953-54 season, plans to refine all the crude oil it produces. Another mill has added equipment to remove the gums from crude oil.

The crude oil that is not tendered to the Government under the price support program is sold primarily through brokers, although small amounts may be sold directly to refiners. In 1953-54 the brokerage was $30 a tank car. The broker actually sells the oil to a buyer and from then on the mill deals directly with the buyer. The oil is sold f.o.b. the mill usually in railroad tank cars, although some oil is transported by tank trucks.

Quality of the oil is determined by official testing laboratories. An official sample is drawn from each car of oil and divided into three parts. One part is sent to a laboratory for analysis, one is sent to the buyer who has an analysis run and one is kept by the mill. If the buyer does not question the laboratory analysis, settlement is made on that basis. In cases where the buyer questions the analysis, settlement may be made by taking an average of the laboratory analysis and that of the buyer. In case of disagreement as to analysis, the remaining sample is often referred to another laboratory and agreement reached beforehand to settle in accordance with results obtained. As a rule, cooperative mills make settlement on the original sample submitted to the laboratory.

Crude cottonseed oil is sold on the basis of color, flavor and odor, and refining loss. Color and refining loss can be accurately measured by chemical analysis. Flavor and odor are judgment factors with free fatty acid content of the oil an important consideration.

Crude oil is sold according to rules of the National Cottonseed Products Association. These rules provide for purchase discounts for off color and off flavor and odor. A discount is also provided for oil that refines with a loss in excess of 9 percent. Producer premiums are allowed for refining losses less than 9 percent.

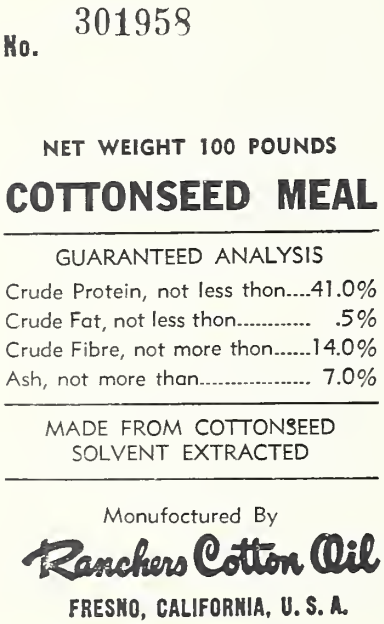
For the most part, cooperative mills have been able to sell their oil at a premium. Average refining losses varied from around 5 to 9 percent, but for most mills refining losses were around 6 to 7 percent. Based on

almost 3,000 samples, average refining loss in 1953-54 was 6.3 percent. Average refining loss was 5.8 percent for solvent mills, 6 percent for hydraulic mills, and 7 percent for screw press mills.

Cake or Meal

Cake or meal is the second most valuable product obtained from cottonseed. Roughly, meal makes up about 45 percent of the weight of seed and about 30 percent of the value of products.

Since cottonseed meal is a high protein feed, it is used principally in livestock feeding - primarily for cattle and sheep. Except under controlled processing conditions, the meal contains a substance known as gossypol which is toxic to swine and poultry if fed in appreciable amounts.



Meal is usually sold on the basis of protein content and with a guarantee of around 41 percent which makes it valuable as a supplement to other feeds that are low in protein. Trading rules of National Cottonseed Products Association provide purchase discounts for cottonseed meal and cake with a protein content less than the guarantee. Most States require labeling the meal to show the analysis.

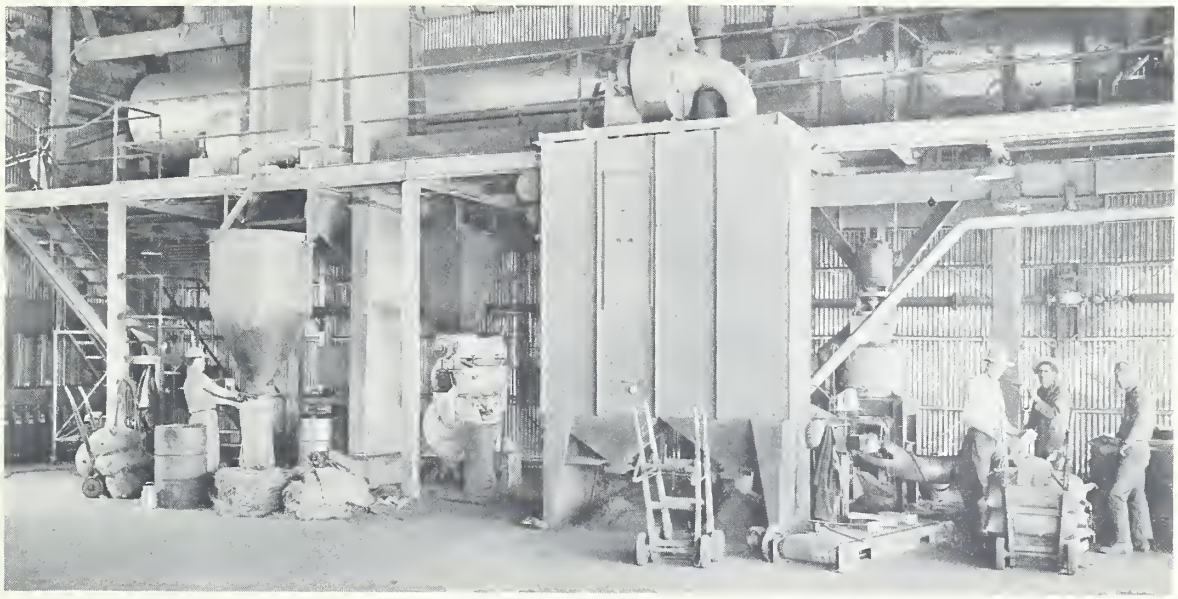
Production of cake and meal naturally follows the same seasonal and yearly pattern as production of oil. Heaviest months are from September through February. Contrary to oil, demand for meal follows in general the same seasonal pattern as production, since demand for meal for livestock feed is greatest during the fall and winter months both in the feed lot and on the range. Small amounts of cottonseed meal, probably less than 10 percent, are used for fertilizer; human use in the form of flour, glue, and plastics; and other industrial uses.

Jamieson[9] states, "American cake and meal contain the following percentages of constitutents when made from decorticated seed: Moisture 7 to 9, oil 6.5 to 7.0, proteins 32 to 42, carbohydrates 28 to 33, crude fiber 10 to 15 and ash 4.8 to 6.0. It is deficient in vitamin A."

According to Cox,[10] "A ton of cottonseed meal contains about 4 pounds of available phosphoric acid, 138 pounds of nitrogen, and 36 pounds of potash."

[9] Jamieson, George S. Vegetable Fats and Oils. 508 pp. Reinhold Publishing Co., New York, N. Y. 1943.

[10] Cox, A. B. The Cottonseed Crushing Industry of Texas in Its National Setting. 346 pp. The Cotton Research Committee of Texas, University of Texas. 1949.



In this cooperative mill's meal room cottonseed meal is processed. This product comprises about 45 percent of the weight of cottonseed.

Cooperative mills sell their meal to a number of different outlets depending largely on their location with respect to livestock production. Mills located in areas where there is little livestock sell only a small proportion of their meal locally. When meal is disposed of some distance from the mill, it is usually sold through a broker. The broker, whose function is to bring buyer and seller together, does not handle the product but arranges for direct shipment from mill to purchaser. The usual brokerage fee is 25 cents a ton. Four mills located in livestock producing areas sell all their meal directly to gins, ranchers, and feed stores. In these direct sales, mills perform the retailer's function and generally receive a higher price than for sales in carlots.

Similar to oil, the outturn of meal per ton of seed varies considerably in the United States from season to season. During any one year, average outturn also differs rather widely between States or areas and even between mills in the same general area. The amount of meal produced depends primarily on ammonia and moisture content of seed and protein and moisture content of the meal produced. Type of mill should have no influence on amount of meal produced as it does in the case of oil.

Table 5 shows a comparison of amount of meal per ton of seed crushed by all mills in the United States and cooperative mills for a 6-year period with the difference not so pronounced as in the case of oil. However, variation in production of meal between cooperative mills is pronounced. For example, in 1953-54, the range was from a low of 854 pounds to a high of 1,023 pounds.

Other things being equal, the greater the amount of oil extracted, the less the amount of meal obtained, but protein content of the meal will be higher. However, protein content of meal is controlled by addition

of hulls. In other words, as oil extraction efficiency is increased. the least valuable cottonseed product, hulls, is used to replace the most valuable product, oil.

The bulk of cottonseed cake or meal produced is 41 percent protein, followed by smaller amounts of 43 percent and 36 percent protein content. There is also a small amount of 28 percent protein content cake or meal which results from crushing unhulled cottonseed.

The 41 percent protein meal is equivalent to 8 percent ammonia cake. To produce such cake or meal, 94 percent of the ammonia content of seed must be left in the cake or meal. The following formula can be used to determine number of pounds of 41 percent cottonseed meal in a ton of cottonseed:[11]

$$\frac{\text{Percent of ammonia in seed} \times .94 \times 2{,}000}{8 \text{ percent}}$$

In accordance with this formula each 1 percent of ammonia in the seed is equal to 235 pounds of 41 percent protein meal. Thus, 4 percent ammonia seed should produce 940 pounds of 41 percent meal.

The protein is shipped out in various forms. From a hydraulic process the cake is in the form of a slab, which may be sold as slab cake or it may be cracked in a cake breaker, screened for size, and sold as sized cracked cake. It may be ground in a hammer or attrition mill and sold as meal either in bulk or in bags. The meal may also be conditioned with steam and run through an extrusion type pellet machine and pressed into pellets for livestock feeding. Many farmers and ranchers prefer pellets for feeding livestock.

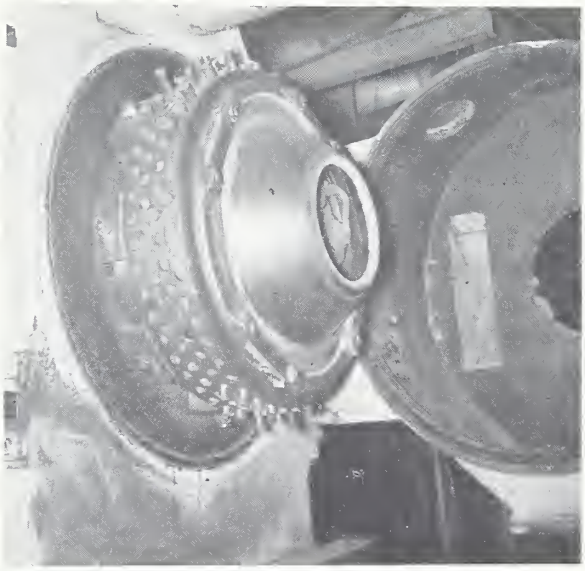
The cake from screw presses is in irregular size pieces and may be sold as sized cake, ground into meal, or made into pellets. The residue from solvent extraction, which is in the form of flakes or much finer particles than from the mechanical pressing, is always sold as meal or pellets. Where the oil content is less than 1 percent, difficulty is experienced in pelleting on an extrusion type machine.

Some mills use another type machine that molds meal into pellets. Ordinarily pellets are produced in 2 sizes, 1 for cattle feeding and a smaller size for sheep and calves. Cottonseed hulls are added to reduce the protein content of meal to the analysis desired. The hulls are added at the time meal is ground by some mills, and just before extraction by others.

Some mills in the cattle producing areas are equipped with feed mixing equipment and furnish feeds of various formulas for their customers.

[11] Rules National Cottonseed Products Association, Memphis, Tenn.

Bulk shipment of cottonseed meal is growing in importance. In 1952-53, cooperative mills as a group sold 22 percent of their meal locally. Of this, 6 percent was sold in bulk, 42 percent as sacked meal and 52 percent as pellets. Wholesale shipments accounted for 78 percent of their meal sales with 12 percent being slab cake, 10 percent bulk meal, 51 percent sacked meal and 27 percent pellets. Local sales usually bring a premium of $3 a ton over wholesale. Pellets usually bring $2 a ton over sacked meal of equal protein content. Bulk shipment saves the cost of bagging.



This machine makes as many as 18 tons of cottonseed pellets an hour. Pellets are used to feed cattle and sheep.

All cooperative mills have some storage space for cake or meal depending a great deal on where the mill is located with respect to livestock areas. Most of them in the nonlivestock areas have around 200 tons and in the livestock areas, 500 tons or more. In 1952-53, the range was from 50 to 2,000 tons for regular storage. As the crushing season progresses, it is possible to store meal in seed houses.

Linters

For upland cotton, linters usually make up around 10 to 12 percent of the weight of cottonseed as it comes from the gin but may range from around 7 to 15 percent. They comprise about 13 percent of the value of products. However, the amount of linters left on seed as it comes from the gin varies a great deal from area to area throughout the cotton belt. This is due largely to variety of cotton grown and extent to which the gin removes lint from seed.

Linter production, of course, depends on size of the cotton crop and where it grew. It has been around 1 million bales or better each year since 1937 and amounted to more than 1.7 million bales in 1952 and 1953. Production is seasonal depending on rate of seed crushing.

The amount of linters removed at the mill is influenced by amount of fiber on seed at the time it is received, as well as the extent to which the oil mill does a complete job of delinting. Price of linters is a factor here.

Table 5 showed average outturn of linters for the United States and for cooperative mills from 1948-49 to 1953-54. During this period, average quantity of linters obtained ranged from 176 pounds to 186 pounds for

the United States and from 169 pounds to 202 pounds for cooperative mills. Average amount obtained per cooperative mill varied considerably each year. During the 6-year period, high mill in production of linters obtained on an average from 77 to 132 more pounds of linters from each ton of cottonseed than the low mill. Even with a low price for linters, the difference amounted to several dollars per ton of cottonseed crushed.

First cut linters comprised 27 percent of the 173 pounds outturn of linters by the 13 cooperative mills in 1953-54. This proportion of first cut linters to total linter production by the cooperatives compares favorably with production for the United States as a whole. According to the United States Bureau of the Census[12] during the 6 years, 1948-49 to 1953-54, production of first cut linters in the United States each year fell within a range of 24 to 28 percent of total linter production.

Individual mills vary considerably in the proportion of first cut linters to total linter production. The proportion by cooperative mills in 1953-54 ranged from 14 percent to 41 percent.

The United States Department of Agriculture has set up seven grades for cotton linters. For the most part, first cut linters fall into grades 1 through 4 and second cut into grades 5 through 7. Mill run linters fall largely into grades 4 through 6. Each grade may be further divided into low, middle, and high. These grades are based on four factors that influence the value of linters: Staple, content of foreign matter, color, and character.

Cotton linters probably have a wider variety of end-use markets than any other cottonseed product. They enter the market in so many different products it is difficult to determine all the commodities for which they are used.

Small amounts of first cut linters, primarily grades 1 and 2 containing the long fibers, are used in the manufacture of twine, yarns, mops, wicks, and medical supplies such as surgical dressings, absorbent cotton, and swabs. The remainder of first cut linters are used primarily in the batting, padding, and felting trade such as automobile and furniture padding and bedding. For the first cuts, principal competition comes from low-grade cotton, textile mill waste, kapok, foam rubber, and hair. This class of linters is usually sold on actual samples. Brokers and dealers handle the bulk of these linters.

The second cut linters which fall into grades 5 through 7 are used largely by the chemical industry. Around 60 percent of total linters consumption in the United States is by chemical firms. These linters are composed largely of cellulose which makes it possible to convert

[12] U. S. Bureau of the Census. Cotton Production and Distribution. Bul. 189. 1952.
U. S. Bureau of the Census. Cotton Production and Distribution. Bul. 191. 1954.

them to innumerable uses. "Clean" cotton linters are almost pure cellulose, 88 to 96 percent, but linters as they leave the oil mill contain many kinds of foreign matter in varying amounts which reduce the cellulose content. The standard for cellulose content has been set at 73 percent. The range may be from 65 to 85 percent. Purchase discounts are allowed for cellulose below 73 percent and producer premiums for that above 73 percent.

Chemical uses for second cut linters include rayon, plastics, explosives, meat casings, paints and lacquers, cellophane, films, linoleum, and storage battery cases. Wood pulp is the principal competitor of chemical grades of second cut linters.

Sale of second cut linters is often made by the mill direct to the manufacturer but may be handled by brokers or dealers.

In the absence of a government price support program, most mills sell their linters through brokers. A few co-op mills sell all or part of their linters directly to manufacturers without going through brokers. The usual brokerage fee for selling linters is 5 cents a hundred pounds.

All but one cooperative mill provides some covered storage for linters; this is important except in areas with little or no rainfall. The mill in California has no inside storage for linters. At times, the mill in El Paso, Tex. stores some linters outside.

Storage capacity for linters at various cooperative mills ranges from 600 to 3,000 bales. Some mills follow the practice of selling linters about as fast as produced. Others at times accumulate their stocks for several months.

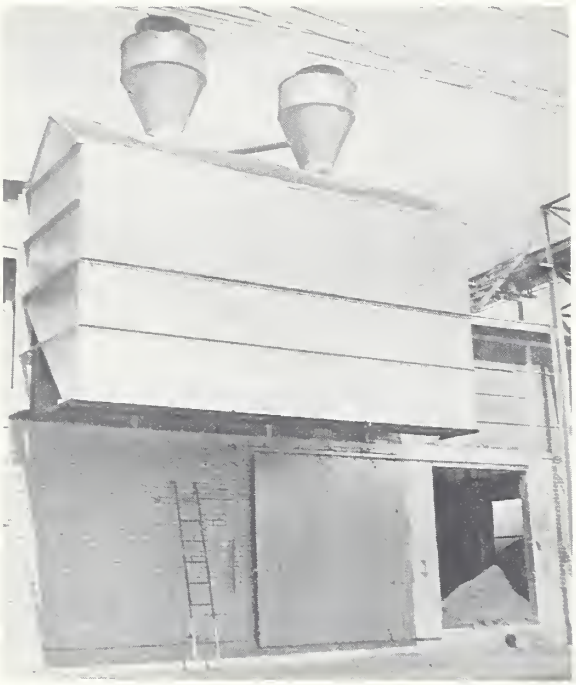
Hulls

Hulls are the least valuable cottonseed product. They account for around 20 to 30 percent of the original weight of seed but only about 3 percent of the total value of products.

Total hull production depends on size of the cotton crop. In the ô crop years, 1948-53, production was more than 1 million tons in all but 2 years. The range was from 857,000 tons to 1,338,000 tons. Demand for hulls, like that for cottonseed cake or meal, follows the seasonal production pattern, since hulls are used primarily for livestock feeding.

Table 5 showed the 6-year production of hulls per ton of seed crushed by all mills in the United States and by cooperative mills. There is considerable difference in amount of hulls produced per ton at the various mills. The range in 1953-54 at cooperative mills was from 371 to 539 pounds. Hull weights include weight of residual lint not removed in the delinting process.

Originally, hulls were used primarily as fuel for mill operations but they are currently used principally as a source of roughage for cattle feed. Jamieson[13] cites the following percentages from a typical analysis of cottonseed hulls: Moisture 8 to 9, ash 2.6, protein 3.5, carbohydrates 38, crude fiber 46, and oil 1. Hulls are classed as a low protein roughage and have a feeding value about equal to prairie hay, oats, or straw from wheat or rice. Probably 85 to 90 percent of the hulls produced are used in livestock feeding. Other uses include stuffing and packing material and soil conditioners. In the chemical industry hulls are used in making plastics and furfural.



From this hull bin trucks load hulls to go to livestock feeders or to mixed feed manufacturers.

Because of their bulk, about twice that of cottonseed, hulls are especially suitable for mixing with concentrates in feeding livestock. In the livestock areas, a popular feed is the "20-80" mix consisting of 20 percent cottonseed meal and 80 percent cottonseed hulls. About half the cooperative mills make this feed mix, using from 10 to 50 percent of their production in this way.

Hulls are bulky to store; consequently most of the mills sell them about as fast as they are produced. As a result, their production follows somewhat the same seasonal and yearly pattern as that of oil and meal. In non-livestock producing areas, where cottonseed hulls must be transported considerable distances, they usually move out in carload lots. In livestock producing areas, hulls usually move by truck to nearby farms and ranches or direct to commercial feeders. Because of their bulk, hulls are seldom sacked. Generally, large quantities are not stored at the mills. The amount of storage available for hulls at cooperative mills ranges from a few tons up to 2,000 tons. Only 3 mills had storage for 1,000 tons or more in 1952-53.

Location of the mill largely determines the method of handling hulls. Principal outlet for hulls is directly to livestock feeders or to mixed feed manufacturers. Mills located in livestock producing areas sell most or all of their hulls directly while those outside livestock areas sell their hulls through brokers. However, mills use brokers much less

[13]Jamieson, George S. Vegetable Fats and Oils. 508 pp. Reinhold Publishing Co., New York, N. Y. 1943.

in selling hulls than in any other cottonseed product. The usual brokerage fee for selling hulls is 25 cents a ton. Because of their bulkiness and low price, hulls usually are not shipped long distances; few of them move out of the cottonbelt.

Manufacturing Loss

Each ton of cottonseed weighed into a mill does not yield 2,000 pounds of cottonseed products. Differences in the combined weight of the four products obtained and weight of seed is working or manufacturing loss. This is due primarily to moisture loss in processing since foreign matter in excess of 1 percent in seed is deducted from the delivered weight of seed.

Moisture content of seed varies widely over the cotton belt in any given year and from year to year, depending on the weather during harvest. For crops of 1947 through 1952, average moisture content of cottonseed graded in the United States ranged from 9.5 to 12.8 percent.[14] Area differences were wide. In 1953-54, average moisture content of seed received by cooperative mills was 8.6 percent with a range between mills from 7.2 to 10.2 percent. The normal range for these mills would probably be from 7 to 15 percent. It was dry over the belt during the 1953-54 harvest.

Table 5 showed average manufacturing loss per ton of seed crushed for the United States and for cooperative mills. The range in manufacturing loss for cooperative mills in 1953-54 was from 19 pounds to 126 pounds. In some years maximum manufacturing loss was around 200 pounds per ton. This occurred when seed came to the mill with a very high moisture content.

SAMPLING AND ANALYZING PRODUCTION SEED AND PRODUCTS

As already pointed out, all cooperative mills sample and grade cottonseed as it is delivered. Grades are far from consistent during the season and between members for any given mill. Since seed is commingled in storage and some factors such as moisture and free fatty acid content may change during storage, it is necessary for the mill to test and analyze seed and products during the milling process to maintain effective mill control.

Production Seed

It is the general practice among cooperative mills to periodically analyze samples of seed going into production. The sample is usually taken in the cleaning room. Most mills take daily samples but the practice varies, depending on seed uniformity. Some mills have the same factors analyzed as when seed is received. Others omit quality and

[14] Agricultural Statistics 1954. U. S. Department of Agriculture.

quantity indexes and grade. Some mills obtain the expected yield of each of the products based on standard milling efficiency. (See figure A on page 45.) From the production seed analysis, it is assumed 2 pounds of oil will be absorbed by linters and 4 pounds of oil will be left in hulls per ton of seed crushed. Some mills have their own laboratories and run their own analyses. Others depend on commercial laboratories.

Linters

More than half the cooperative mills take periodic samples of second cut linters and have them analyzed for moisture and cellulose content. Many of them do this daily while others run a weekly analysis. Carlot shipments of second cut linters are sampled and sold on the basis of cellulose content. Commercial laboratories do this analysis work. (See figure B on page 45.)

To determine the efficiency of lint room operations, most mills take a sample of seed after delinting (black seed) and have them analyzed for the amount of residual lint. Efficient milling requires that residual lint should be around 2 percent or lower. In 1953-54, cooperative mills had 1,321 black seed samples analyzed and the average residual lint was 2.3 percent with a low of 1 percent for one mill and a high of 3.4 for another. Most of the mills run a daily analysis while others check weekly. (See figure C on page 45.)

Hulls

As a check on operating efficiency, particularly separating equipment, practically all cooperative mills sample hulls and have them analyzed for oil content. The analysis usually shows amount of oil in whole seed and uncut meats, in meats or meal particles, and in clean hulls. Several mills run daily samples, others weekly or occasionally. (See figure D on page 45.) During the 1953-54 season, cooperative mills had 1,375 hull samples analyzed; they showed an average oil content of 0.52 percent.

Meal

There is more sampling and analysis of cottonseed protein in its many forms, such as slab cake, press cake, meal, and pellets than of any other cottonseed product. Analysis determines four primary factors: (1) Moisture content, (2) ammonia content, (3) protein content and (4) fat content. Nitrogen content and milling standard are other factors often determined. Currently, some mills analyze for protein solubility. Practically all cooperative mills analyze samples for each shift and many screw press mills analyze samples for each press. (See figure E on page 45.)

Mills also analyze pellet and cube samples. In addition they sample and analyze each car of cake, meal, or pellets. Some screw press mills run an analysis on the cake as it comes from the presses and again after

Daily Crushed Seed Report

FOR Osceola Products Co., Osceola, Ark. 10/8/53

24 hrs. ending 7 a.m. 10/7

COTTONSEED (A)

Dirt & Trash	XXX %
Moisture	8.4 %
Oil	19.0 %
Ammonia	3.99 %
FFA	0.5 %
Lint on seed	11.3 %

Expected Yields Basis Standard 80

Oil	309 Lbs. per ton
Cake (8% Ammonia)	921 Lbs. per ton
Linters (1.5 % lint left on seed)	212 Lbs. per ton
Hulls	494 Lbs. per ton
Mfg. Loss	64 Lbs. per ton

NOTE: Calculations based on 1980 lbs. clean seed, 2 lbs. oil in linters and 4 lbs. oil left in hull, and average moisture on seed analysis received by the laboratory to date 9.0 %

	SHIFT			RAILROAD CARS		
	8 to 4	4 to 12	12 to 8	SLSF 130256	CB&Q 17626	UP 197214
Marked						
Moisture	9.38	9.56	10.38	8.88	9.86	9.20
Oil	1.98	2.12	1.56	2.16	2.06	2.28
Ammonia	8.10	7.90	8.10	8.30	8.25	8.05
Protein	41.63	40.63	41.63	42.63	42.38	41.38
Standard	.24	.27	.19	.26	.25	.28

Hull Production .56 (E)

To Mid-West Cooperative Oil Mill
Hamlin, Texas

Sample of Cake

Received 4-20-53

Marked Cake Press #3 4-18-53

Nitrogen	7.03 %	Protein	43.94 %
Ammonia	8.55 %	Oil (Ext)	4.20 %
Moisture	2.40 %	Total	48.14 %
Extraction Standard	49		(F)

Official Method of National Cottonseed Products Association Employed in this Analysis

Remarks:

To Ne-Tex Co-Operative Oil Mill
Wolfe City, Texas

File No.

Date Rec'd. 10-13-52

Report of Tests on Second Cut Linters (B)

Received from You

Identification Marks 10-10-52 NKP 7165

Moisture ---------- 4.0%

Cellulose yield ---------- 79.9

Sample of: Mix Feed
For: Plains Cooperative Oil Mill, Lubbock, Texas

Received: 11-8-52
Marked: 20/80 11-8-52 (G)

— Analytical Results —

Protein	10.94
Oil	2.06
Moisture	8.24

Sample of Delinted Cottonseed

Marked 3/7 (C)

Officially Sampled By

C. C.

Residual Lint on Seed ... 1.2% or 24 # per ton

Sample of HULLS

Received 2-26-53 (D)

Marked 2-25-53

Whole Seed	.20 %	Oil in Total Meats	.08 %
Meats in Whole Seed	.12 %	Oil in Cleaned Hulls	.40 %
Whole Meats	%	Total Oil	.48 %
Meat Dust	.11 %	Oil in Lab. Cut Hulls	0.25 %
Total Meats	.23 %	Oil Loss in Hulls	.23 %

* This is on arbitrary assumption

Remarks:

Osceola Products Co.
Osceola, Ark. 11/20/53

(?)

Method Regular (Extracted)

Marked Seeds

Shipped to

Officially Sampled By

C.C.

Free Fatty Acids			0.6 %
Refining Loss			6.3 %
Color Refined Oil		35 Yellow	4.5 Red
Flavor Refined Oil			Prime
Flavor of Crude Oil			Prime
Grade			Prime
Color Bleached	20	Yellow	1.0 Red
Refined with	5.5 % of	14	Caustic Soda

Actual Analysis of Cottonseed and Cottonseed Products

it has been processed into meal. The cake directly from the presses has a lower moisture and higher protein content than the resulting meal after moisture has been added. (See figure F on page 45.)

There are three primary purposes for so much testing of meal. One is to enable the mill to control ammonia or protein content since that is the basis on which most meal is sold. The mill receives a price for meal based on a specified protein content, and shipping meal of a higher content is not good business. Prices are discounted if the protein does not come up to specifications.

A second purpose is to check fat content of the meal. The aim is to take out as much oil as possible, consistent with the type of process, since oil left in meal sells for meal prices which are much lower than oil prices. As additional oil is removed, protein content increases and hulls can be used to replace the oil. Analyzing for fat is also a check on press room extraction efficiency.

The third purpose is to check moisture content of the meal. Meal or pellets with too high moisture are subject to spoilage in storage or transit. On the other hand, the mill cannot afford to ship meal with extremely low moisture, since this would adversely affect outturn and revenues. Mills ship most meal at around 8 percent moisture.

Average protein content of meal for cooperative mills in 1953-54 was 41.25 percent. Average fat content was 3.44 percent. The type of process materially affects residual fat. In 1953-54, average fat content was 4.98 percent for hydraulic mills, 4.44 percent for screw presses, and 1.33 percent for solvent mills. In other words, assuming 900 pounds of meal produced per ton of seed, hydraulic mills were leaving 45 pounds of oil in their meal, screw press mills 40 pounds, and solvent mills 12 pounds.

In livestock areas, many cooperative mills mix feed for their customers. One of the most common ones is known as "20-80" mix. This mixture is usually sold with a protein guarantee of 11 percent. Mills sample this mix occasionally and have it analyzed for protein, moisture, and fat content. (See figure G on page 45.)

Oil

Each car of crude oil is officially sampled before shipment and copies of the report on analysis furnished both buyer and seller. The buyer also samples and analyzes the oil when the car arrives at its destination. (See figure H on page 45.)

In addition to the official analysis on each tank car of crude oil shipped, several cooperative mills take unofficial samples of the oil produced each shift and have them analyzed. They may have all the factors or any combination of the factors analyzed, as in the case of an official sample.

The accumulation of data from all these analyses on seed and products enables mills to do a more efficient job of crushing seed and to have better control of operations. They can pick out trouble spots, correct them, and know at all times where they stand with respect to their crush.

CALCULATING DAILY TONNAGE CRUSHED

Cottonseed as weighed into the mill upon delivery contains varying amounts of foreign material, moisture, and cottonseed products. Foreign material in excess of 1 percent of the weight is deducted from the delivered weight. This weight changes during the storage and crushing processes due to gains or losses in moisture content of seed and removal of foreign material.

Although the mill grades seed at time of delivery, it is commingled in storage so that the mill does not know the composition of a specific tonnage crushed. It is only by sampling and analysis, discussed in the preceding section, that a mill can determine its crushing efficiency.

The only time cottonseed is weighed by the mill is when it is received. It is not weighed at the time it enters the crushing process. Neither are products weighed as they are produced unless they are shipped immediately. Since all mills maintain a record of the daily tonnage crushed, the question arises as to how they obtain this figure. The answer is by estimation based on results of analyses of seed and products.

Methods and practices used by the 13 cooperative mills reporting in 1953 for calculating daily tonnage crushed were not uniform. Five mills used oil only as the basis. Most of these mills measured the total oil produced daily by taking the inches in the oil storage work tank and converting to pounds by a formula. This figure was divided by expected oil to be produced per ton of seed crushed. The figure for expected oil was available from analysis of the seed sampled for mill control but was based on the hydraulic standard.

Several of the solvent mills obtained an expected yield by taking the oil content of seed as shown by the seed analysis and subtracting the estimated amount of oil left in the meal, hulls, and linters as shown by the product analyses.

Another five mills used a combined meal and oil figure to calculate tons crushed per day. The oil produced per day was measured and converted to pounds. To this was added the weight of the meal produced. This total was divided by total expected production of oil and meal per ton of seed crushed as shown by analysis of seed going into production.

One mill used meal only as a basis. Still another used oil plus cake plus linters while a third mill used these three factors plus weight of hulls plus estimated manufacturing loss.

Since it takes at least 24 hours to get the results from a seed analysis, it can be seen that the calculations are based on seed that has already been crushed and products that have already gone to storage or have been shipped. That is, the seed is already crushed before the analysis or composition of the seed is known. However, as the crushing season progresses, the cumulative figures become more reliable and at the end of the season will average out.

All of the products are weighed either as they are produced or shipped. Products such as linters, hulls, and meal can gain or lose weight if stored before shipment so that the weight of products at time of production may be different from shipping or sale weight. However, it is the general practice that daily production of each product is calculated pretty much on the same basis as daily tonnage crushed. That is, after the estimated figure for daily tons crushed is calculated, the expected yield per ton of products is applied to this figure to obtain the day's production.

It is the general practice among these mills to be conservative in calculating daily tonnage crushed; as a result most of them end the crushing season with an overrun. That is, when cumulative daily tonnage crushed is subtracted from cumulative receipts, there comes a time when the receipts figure has disappeared and the mill still has seed to be crushed.

Some mills aim for an overrun. Other mills like to come out even and very nearly do so by changing the basis for calculating daily tonnage crushed fairly frequently in accordance with changes in analyses. The overrun usually amounts to 2 percent or less but does go as high as 5 percent. Occasionally, a small underrun results.

Sometimes the fiscal year ends and the books must be closed before the seed is all crushed. Such a condition creates a problem of inventories. There is a theoretical inventory figure on the books and there is no practical way of physically measuring the seed on hand.

The problem is accentuated by an overrun and also by the values placed on the inventory. Most mills price inventories at either cost or market -- whichever is lower, close the books at the end of the fiscal year, and make allocations to the members on the number of tons received. They continue milling and have a final statement of operations so that any gains or losses over the inventory can be allocated to the seed suppliers for the prior year.

This is a step in the right direction and a practice to be commended since its use would eliminate some inequities due to membership or patronage changes among members.

Another possibility would be use of the inventory method. When the books are closed at year end, each patron would be given credit for his proportional share of the estimated inventory (seed and unsold products). To this would be added his deliveries, if any, for the following year.

At the close of the following year, if there were still an inventory it would be subtracted to get the results for the current year.

By this method, it would be possible for a patron who delivered no seed during the year to receive an allocation because of his interest in the beginning inventory. This method might be simpler than the one mentioned previously.

From the foregoing discussion, it can be said that crushing cottonseed is not a precise operation. The entire operation is based on estimates which point out the necessity for accurate, representative sampling and analysis of seed and resulting products. Those people responsible for mill operations must exercise good judgment based on knowledge and experience, if an efficient crushing job is to be done.

BUSINESS OPERATIONS

Cooperative cottonseed oil mills are established businesses with the same problems as other similar undertakings. They need large amounts of capital. They must have plants, equipment, and a labor force. They incur marketing risks. They must have insurance and they need to handle public relations problems adequately.

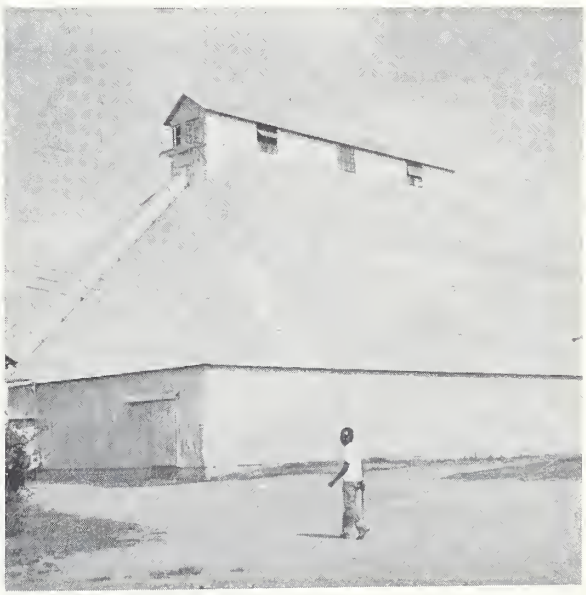
Investment Needs

A cottonseed oil mill with its seed houses, mill buildings, product storage, office, and all necessary machinery and equipment for handling seed from the time it is received until shipment of products is an elaborate industrial plant.

Financial requirements for investment in both facilities and operating capital for such a plant are quite large. The minimum investment in land and facilities for a modern oil mill, large enough for economical operation, is close to $1 million.

For the most part when the cooperative cottonseed oil mills were organized, members furnished enough capital so the remaining amount necessary to purchase the oil mill could be borrowed. Most associations borrowed from the banks for cooperatives.

Members of older cooperative mills have built up substantial equities in their associations so



This is an "A" type seedhouse, the kind most commonly used to store cottonseed until it can be processed.

that financing their facilities is no longer a problem. Some newer mills and older mills that have recently modernized their plants still have substantial facility loans.

The investment in an oil mill does not increase in proportion as capacity is increased. The Agricultural Marketing Service, U. S. Department of Agriculture, in Marketing Research Report 54 shows investment costs for various types and sizes of completely new mills including the necessary land and construction costs as of 1950. These figures, based on engineering estimates, follow:

	Total cost	Cost per ton
1. 10,600-ton annual crush:		
Hydraulic crushing 80 tons per day	$737,000	$9,213
Screw press crushing 75 tons per day	733,000	9,774
Direct solvent crushing 100 tons per day	935,000	9,350
Pre-press solvent crushing 80 tons per day	871,000	10,875
2. 52,800-ton annual crush:		
Hydraulic crushing 200 tons per day	1,548,000	7,740
Screw press crushing 200 tons per day	1,575,000	7,875
Direct solvent crushing 200 tons per day	1,628,000	8,140
Pre-press solvent crushing 240 tons per day	1,826,000	7,608
3. 105,600-ton annual crush:		
Hydraulic crushing 400 tons per day	2,745,000	6,863
Screw press crushing 400 tons per day	2,782,000	6,955
Direct solvent crushing 400 tons per day	2,675,000	6,688
Pre-press solvent crushing 400 tons per day	2,883,000	7,208

From these figures, it can be seen that there is not much difference in cost by type of mill. Except in the case of a hydraulic mill producing slab cake only, conversion of an existing plant to another type of extraction process of equal capacity would not be so expensive. The primary cost would be extraction equipment and its installment costs.

Since financial requirements for operating capital are quite large for a cottonseed oil mill, it is necessary for all the cooperative cottonseed oil mills to borrow money to carry on their operations each season. It would be uneconomical to build up enough capital to take care of seasonal demand. Seed must be accepted when the patron delivers it to the mill and he must be given a substantial advance or the current market price for the seed, depending on the practice followed. Since seed moves to the mill much faster than it can be processed and the products sold, the mill needs considerable money to finance advance payments on seed. In addition, large sums of money are necessary to pay operating costs at the season's beginning before the mill receives payment for its cottonseed products.

Some larger cooperative mills need a line of credit of several million dollars to take care of payments for seed as delivered and to meet operating expenses. Most of them borrow from banks for cooperatives to carry on their operations while a few are financed by commercial banks. At those mills where an advance payment is made for seed, the member is helping carry the risk and reducing the need for borrowed capital. At some federated mills, the gins have let their seed money accumulate thus reducing the need for outside capital.

Cooperative cottonseed oil mills have been good credit risks. Not a single dollar has been lost by cooperative banks on any loans made to them.

Property Needs

Most cottonseed oil milling plants built today will cost from a million dollars up to several million dollars, depending on size and type. Conversion from hydraulic presses to screw presses or solvent extraction runs into considerable money, and converting from screw presses to solvent extraction is also expensive.

With one exception, all the cooperative cottonseed oil mills were established by purchasing existing mills. At the time of acquisition many of them had not been used for a number of years. In all cases, considerable repair and modernization were necessary. After acquisition, most of them expanded their extraction capacity which usually called for expansion and adjustments in other departments of the mill. In only one case was a completely new mill built.

Considerable land is needed for buildings and equipment necessary in carrying on various operations in receiving, storing, and processing cottonseed. Each cooperative mill owns the land on which it is situated. The amount owned ranges from about 4 city blocks to as much as 140 acres with most of them having 5 to 10 acres.

The center of an oil mill, from the business and administrative standpoint, is the office where manager and office force are located. The office is usually in a separate building but close to other mill buildings for efficient supervision. Scales for weighing truck seed as they arrive at the mill and for weighing out products shipped by truck are usually nearby and office personnel operate them.

For convenience and economy, seed unloading equipment is near seed houses. Sterilizers are also conveniently located near unloading equipment since seed is sterilized before storage. The number of seed houses ranges from one to eight and they have an individual capacity of from 5,000 to 18,000 tons. Seed houses are usually constructed of galvanized iron with concrete floors. Most houses are equipped for aeration and are fitted with screw or belt conveyors operated by electric motors for moving seed into and out of them.

The mill office building is the center of administrative and business operations. To the left are scales on which office personnel weigh in truck seed and weigh out products shipped by truck.

The mill building is the largest structure and the processing center of a cottonseed oil mill, particularly a mechanical mill. These buildings, often several hundred feet long, contain all machinery and equipment for cleaning department, linter room, bale press, huller or separation room, press room, meal room, and feed plant, if any. Meal storage is usually in this building.

The same is true for solvent mills except that they have a separate building for extraction. Solvent buildings at two cooperative plants contain necessary machinery and equipment for preparing and conditioning cottonseed meats for extraction in addition to the extraction tower itself. All machinery is operated by electric motors. Screw conveyors of various sizes, hundreds of feet in length, move seed and products.

The mill building is located on a railroad siding which extends to each cooperative mill for convenience and economy in loading products for shipment. Other buildings include linter storage, hull house, boiler house (if not located in the mill building), and shops. Hull and linter storage are also located near the railroad siding. The bale press is sometimes located in the linter storage building.

The type of construction of the various buildings depends to a great extent on the building's age. At the older mills, many buildings are frame or brick construction. More recently constructed buildings are mostly steel with corrugated steel sheet sidings and concrete floors. Mill offices are usually constructed of brick, frame and stucco, or concrete blocks. Other buildings vary depending on when they were built and type of construction in vogue at that time.

In addition to buildings there are oil storage tanks, solvent storage tanks, fuel oil tanks, electric power substation, water cooling tower, and often a water tower itself. Mills using wells as a source of water also have pump houses.

Breakdown of Operating Costs

All cooperative cottonseed oil mills divide their operating costs into two broad categories.

Largest of these is manufacturing cost which includes those items directly assignable to storing and crushing seed and handling and packaging products. Manufacturing costs include such items as labor, fuel, power, repairs, depreciation, insurance, bagging and ties for linters, meal bags, twine and tags, press cloth, solvent, analysis of seed and products, mill supplies and expenses, and water.

The other category known as general and administrative expenses, or overhead, includes those items not directly assignable to manufacture. Overhead costs cover such items as office salaries, office supplies, brokerage on sale of products, taxes and licenses, legal audit, telephone, telegraph, interest, dues, subscriptions, insurance, truck and auto expense, travel and directors' expense.

A certified public accountant audits records of each cooperative oil mill at the end of each fiscal year and makes an audit report to the board of directors. Since audits are usually made by different firms and different systems of accounts and records are kept at various mills, the audit reports differ in many respects.

Because a different classification of accounts exists at various mills, it is not always possible to compare individual items of operating costs of one mill with another.

Table 6 gives a breakdown of average operating costs for cooperative mills for the 7 crushing seasons, 1947-48 to 1953-54. Items listed are ones most commonly shown in audit reports because they are the largest cost items.

Manufacturing costs make up by far the greater proportion of total operating costs, amounting to 79 percent in 1953-54. Mill wages were much larger than any other item of manufacturing costs amounting to 34 percent of the total. Some other important items were power, repairs, depreciation, and meal bags. These items, including labor, accounted for 79 percent of manufacturing costs in 1953-54. In the general and administrative group, salaries and interest were the two largest items accounting for about 59 percent of the total.

As pointed out, the figures in table 6 are averages for all cooperative mills. Variation among individual mills for the items and even for the totals is widespread. For example, the 13 cooperative mills reporting

Table 3. - *Operating costs of cooperative cottonseed oil mills per ton of seed crushed, 1947-48 to 1953-54*

Item of cost	1947-48 12 mills	1948-49 13 mills	1949-50 13 mills	1950-51 13 mills	1951-52 14 mills	1952-53 13 mills	1953-54 13 mills
Manufacturing costs:							
Mill wages and salaries-	$4.53	$4.66	$4.26	$4.74	$4.77	$4.21	$3.92
Power, lights, water----	1.16	1.06	1.15	1.13	1.14	1.15	1.11
Repairs----------	1.15	1.03	1.32	1.72	1.36	1.38	1.26
Depreciation----------	1.01	.98	1.03	1.46	1.54	1.64	1.52
Mill supplies and expenses----------	.61	.35	.33	.41	.52	.34	.28
Insurance----------	.66	.52	.44	.63	.68	.52	.68
Fuel----------	.58	.48	.35	.40	.32	.33	.32
Laboratory expense------	.18	.17	.19	.16	.18	.19	.19
Meal bags, twine, tags--	1.22	1.27	1.22	1.47	1.74	1.46	1.17
Bagging and ties--------	.30	.32	.33	.40	.44	.35	.34
Other----------	1.09	.56	.45	.58	.29	.37	.58
Total manufacturing cost----------	12.49	11.30	11.07	13.10	12.98	11.94	11.37
General and administrative expenses							
Salaries----------	1.13	.88	.86	1.27	1.14	1.16	1.14
Brokerage----------	.14	.23	.26	.28	.24	.19	.23
Taxes and licenses------	.18	.18	.16	.31	.22	.26	.27
Truck, travel, auto expense----------	.08	.08	.12	.16	.16	.18	.19
Telephone and telegraph-	.07	.06	.07	.08	.09	.07	.07
Exchange----------	.08	.04	.02	.03	.03	.01	.02
Dues, subscriptions-----	.11	.12	.12	.14	.15	.15	.14
Legal and audit---------	.05	.04	.08	.16	.05	.08	.06
Interest----------	.27	.45	.34	.54	.69	.87	.61
Insurance----------	.23	.30	.18	.21	.19	.19	.06
Office expense----------	.08	.05	.07	.06	.05	.06	.05
Other----------	.30	.21	.09	.21	.20	.12	.13
Total general and administrative expenses---------	2.72	2.64	2.37	3.45	3.21	3.34	2.97
Total operating costs----------	15.21	13.94	13.44	16.55	16.19	15.28	14.34

had an average operating cost of $14.34 a ton for the 1953-54 season, but the range was such that the high-cost mill had more than twice the costs of the low-cost mill. Such differences were even more pronounced for many of the individual items making up the total.

Labor Requirements

Labor requirements at the various cooperative mills depend on a number of factors such as type and layout of mill, efficiency with which labor is used, utilization of mechanical handling equipment, size of mill, crushing volume and length of crushing season, number of shifts operated, seed sterilization, pelleting, feed mixing, sack or bulk shipment of meal, and amount of construction and repair work by mill or outside labor.

Requirements for labor at a given mill during a crushing year will vary from a peak during the height of the seed receiving season to a low point during the period when the mill is closed after finishing its crush and before seed receiving for the following year begins. The slow or dormant season is used for cleaning the mill and making major repairs.

All mills have key people who are kept on the payroll the year round. During the slack season, these people are used in any way possible such as construction and making repairs. Major changes in the mill, including installation of new equipment as well as large repair jobs, are delayed, if possible, until this dormant season. Any paid vacations are usually taken during this period. Much of the unskilled labor is dismissed at the beginning of the slow period with the hope that it will be available again when the new crushing season begins.

All mills are divided into departments, the names indicative of the operations carried on in the department. Men working in each of these departments have specific jobs and job titles.

The following list shows usual departments and jobs within the department in cooperative cottonseed oil mills:

1. Seed unloading - seed unloaders, seed house men
2. Sterilization - seed tank and sterilizer men
3. Linter room - seed cleaning, linter men, oiler, lint chaser, saw filer, bale press operator
4. Huller room - separation or huller men
5. Press room:
    a. Hydraulic mills - meal cook, cake former, cake stripper, pan shover, wagon man, cake knocker, press cloth repairmen

b. Screw press mills - screw press operators and helpers

c. Solvent mills - solvent operators and helpers

6. Meal room - sack setters, sack sewers, stackers, cake caretaker

7. Boiler room - engineer

8. Repair and maintenance (shop) - millwright and necessary repair men such as electricians, carpenters, and welders

9. Yard and clean-up - janitors, clean-up men, and watchmen

10. Superintendence - general superintendent, assistant superintendents, and necessary departmental foremen

During the 1953-54 season, 13 cooperative mills supplied labor information. Seven mills were operating on 3 shifts of 8 hours each while the other 6 mills were working on 2 shifts of 12 hours each. In many mills, it is possible to work only one shift in some of the departments and at the same time keep the mill operating at full capacity. The press room is the one department that requires men on all shifts.

In recent years, cost of labor has advanced rapidly with a minimum of $1 an hour now required by law.[15] In order to keep labor costs as low as possible, since this is by far the largest single item of cost in crushing cottonseed, mechanical equipment is rapidly replacing hand labor. Use of fork lift trucks for handling, storing, and loading baled linters is an example. Not many years ago, hand labor almost exclusively handled cottonseed into and out of storage. This practice has all but disappeared and seed is now handled by air, screw conveyors, and conveyor belts.

Mill size, of course, will affect labor requirements; however, the requirements do not increase in proportion to size of mill. For example, a 100-ton-per-day hydraulic mill would probably require only one-third more labor than a 50-ton hydraulic mill. As a general rule, man-hour requirements per ton of daily capacity decrease as size of mill increases.

The principles pointed out apply to all three types of mills. However, the hydraulic mill, because of the large amount of labor required in the press room, has the highest labor requirements of any mill. To operate the press room in a 150-ton hydraulic mill would require approximately 9 men per shift, or about 4 times the number required in a screw press or solvent plant of equal capacity. Other things being equal, the other departments would require the same number of men regardless of the type of mill.

[15]The minimum hourly wage was $.40 per hour to Jan. 1950 and $.75 to March 1, 1956, when it became $1.00.

Because of lack of uniformity in the many factors affecting labor requirements listed in the first paragraph of this section, amount of labor used by cooperative cottonseed oil mills varies widely. Since some mills work on 3 shifts of 8 hours each and some on 2 shifts of 12 hours each, the number of men actually at a mill does not tell the story. Therefore, in order to have comparable figures, the number of man-hours used per day has been calculated. Table 7 summarizes these figures by type of mill and daily crushing capacity.

Table 7. - *Man-hours used daily in 13 cooperative cottonseed oil mills by type of mill, 1953-54*

Type of mill	Number of mills	Daily capacity	Man-hours used per ton		
			Average	Low	High
		Tons		*Number*	
Hydraulic-----	2	212	4.51	3.92	5.94
Screw press---	7	898	2.67	2.00	3.87
Solvent-------	4	1,000	1.99	1.66	2.48
All types	13	2,110	2.53	1.66	5.94

This table shows only normal operating or crushing labor. Temporary peak season labor required during the seed receiving season has been excluded. In terms of man-hour requirements a day, these mills used 5,342 man-hours for normal operations. They used an additional 1,004 man-hours a day in the peak labor period, primarily for receiving and storing seed.

There is a wide difference in the total man-hours used and also in the man-hours used per ton crushed daily. However, a strict comparison cannot be made between individual mills so far as labor efficiency is concerned unless location and conditions at each of the mills are known.

A partial explanation of some of the variations noted in table 7 may be found in table 8, which breaks down the total labor into three major mill departments and "all other."

These figures show wide differences in labor requirements among mills of the same type as well as between types. Hydraulic mills require about 1.7 times the labor of screw press mills and about 2.2 times that of solvent mills. A large part of this is due to heavy labor requirement in the hydraulic press room, but hydraulics are also high in lint room requirements. This is partly because hydraulic mills are older and partly because they have not been able to modernize and make efficient use of labor with their present layouts. Solvent mills on the other hand are relatively new and have improved their layouts and machinery arrangements to use labor more effectively. Solvent mills also process larger volumes; this usually reduces man-hour requirements.

Table 8. - *Man-hours used by 13 cooperative cottonseed oil mills per ton of daily crushing capacity, by type of mill and mill departments, 1953-54*

Type of mill	Daily crushing capacity in tons	Man-hours used in											
		Lint room[1]			Press room			Meal room			All other[2]		
		Average	Low	High	Average	Low	High	Average	Low	High	Average	Low	High
Hydraulic-----	212	1.52	1.28	2.12	1.47	1.28	1.94	.29	.08	.81	1.23	1.10	1.28
Screw press---	898	1.08	.80	1.67	.38	.27	.53	.50	.42	.69	.71	.30	1.20
Solvent-------	1,000	.75	.56	.96	.32	.22	.56	.31	.22	.44	.62	.48	.84
All types	2,110	.97	.56	2.12	.46	.22	1.94	.39	.08	.81	.72	.30	1.28

[1]Includes seed cleaning, lint room, bale press, huller or separation room, lint loading and saw filing labor.
[2]Includes labor in all departments except lint, press, and meal, but excludes superintendence and peak season labor. Includes labor for removing seed from storage, hull handling and storage, mixed feed operations, maintenance and repair, yard and clean-up, and watchman.

Hydraulic mills are low on meal labor because the bulk of their production goes out as slab cake and they do not require labor for meal grinding, sacking, and storage.

Just as there are differences in man-hour requirements by mills, there are variations in wages paid workers. With the exception of the superintendent's force, mill labor is paid on an hourly basis.

Wage rates are affected by such factors as minimum wage laws, availability of labor, prevailing scale of wages in the area and in other industries, type of job performed, degree of skill, length of employment, unionization, and shift worked. Since the great bulk of the labor used in a cottonseed oil mill is in the unskilled class, $0.75 has been the hourly wage most commonly paid. In 1953-54, 22 percent of the employees in cooperative oil mills received a straight $0.75 per hour, 51 percent received $0.85 or less, and 73 percent received less than $1. Seventeen percent received $1 to $1.20 and only 10 percent received $1.25 and over.

Solvent mills paid the highest wages and hydraulic mills the lowest. This is partly because of location of mills with hydraulic mills being located in surplus labor areas. Another important factor is that it takes more skilled labor in solvent plants, and even in screw press plants, than in hydraulic plants. Unskilled labor cannot be used to operate the extraction plant in a solvent mill. The average hourly wage for all cooperative mills in 1953-54 was $0.96 with solvent mills paying $1.11, screw press $0.90, and hydraulic mills $0.77. All these figures

are exclusive of the superintendent's force who are paid on a monthly basis.

Associations usually have 3 to 10 employees in the office in addition to the manager. The manager, some of the office force, superintendent, and key office personnel are on a salary basis. Several mills now pay a large part of the office force on an hourly basis. For the most part, all employees in the mill proper below the rank of superintendent are paid on an hourly basis.

In addition to their fixed salaries or wages, a number of the cooperative mills pay bonuses to their employees at the end of the year's operations. There is no fixed policy but decision each year depends on operating results. The manager usually makes recommendations to the board as to payment of bonuses, other than his own. Bonuses usually are restricted to salaried employees. Any bonus paid to the manager is at the discretion of the board unless the manager has a contract that provides for a fixed percentage of savings.

Mills give employees a number of other benefits in addition to direct money payments. Associations have somewhat different policies with respect to vacations for employees. Most salaried employees get 2 weeks annual vacation with pay. In some cases, from 1 to 2 years of service are required in order to be entitled to a 2-week vacation. It is the usual practice not to give paid vacations to laborers in the mill who are off during the season of the year when the mill is not operating.

Some mills provide houses for a few of their employees at a nominal cost. This helps assure the mill a source of labor.

One cooperative has arranged with a clothing supplier to furnish coveralls for all its mill employees with the mill's brand name stitched across the back. Different colors are used for different classes of employees. The mill launders this clothing. Keeping the coveralls in good repair is an added safety factor as well as a morale builder. The same mill arranges to buy safety shoes at cost for its employees. This practice has reduced accidents.

Employees of some mills have group insurance available to them. In two cases the mill pays one-half the cost. Employees of a few mills have group hospitalization available to them but employees pay all costs.

All mills do something special for their employees at Christmas time. Presents may consist of baskets of food, or money, or both in some cases.

Kinds of Insurance Needed

As pointed out in another section, members of these cooperative mills have a lot of money invested in them and the present replacement value is even greater. In view of this, one important responsibility of the board of directors and the manager is to see that the mill is adequately

insured. This is especially true for cooperatives since the producers are the owners.

An insurance policy is a contract. It is an important document since it contains the basis for settlement of claims in case of loss.

One cooperative mill manager has stated: "The best time to make adjustments for insurance losses is at the time of writing the policy and not at the time the loss occurs. Two points are extremely important: (1) See that all descriptions are adequate and correct and (2) use correct values. Insurance costs money but to have adequate insurance is worth the cost. One of the best ways to have the correct values is to have relatively current detailed appraisals on the mill."

Principal kinds of insurance carried by cooperative mills are:

1. Fire and extended coverage
    a. Buildings, machinery and equipment
    b. Stored cottonseed, cottonseed products, and supplies that go out with the finished products
    c. Furniture and fixtures
2. Workmen's compensation
3. Boiler explosion
4. Breakdown insurance on motors and engines
5. Use and occupancy (business interruption)
6. Fidelity bonds (bond and burglary)
7. General or public liability
8. Product liability
9. Auto and truck insurance

One of the most important types is fire and extended coverage on buildings, machinery, and equipment. Such facilities at several mills are insured for more than $1 million each. This insurance is usually carried by a group of half a dozen or more insurance companies. When more than one company writes insurance on the same property, all policies must read alike in every respect and all schedules must be alike. All cooperative mills carry this insurance and all policies are on a co-insurance basis with 11 mills carrying 90 percent co-insurance policies and the other 3 carrying 80 percent.[16]

[16]Co-insurance is a provision or warranty added to an insurance policy under which the insured agrees to carry an amount of insurance equal to a specified percentage of the actual cash value of the property covered by the policy.

Another important item is fire and extended coverage insurance carried on stored cottonseed, stored cottonseed products, and stored supplies that go out with finished products such as bagging and ties for linters, and bags, tags and twine for meal, feed, and hulls. This is commonly known as stock insurance and the reporting form is used. It is carried at 100 percent of daily value.

The "value" for cottonseed is defined as "the going price in the area of the mill for seed of like quality as of the day of the report, plus the cost of transportation to the mill; unloading charges; sterilization charges; and other handling charges actually expended. Products value is the market value at the mill as of the day of the report."

The amount of this insurance carried, of course, depends upon the value and amount of seed and products stored and decreases as seed is milled and products shipped. At the peak, such insurance coverage may involve several million dollars for any one mill. Eleven cooperative mills report their values on a monthly basis and the other three on a weekly basis.

Office furniture and fixtures insurance is carried by all cooperative mills. These policies are similar to those on buildings and equipment, and in fact, may be included in building and equipment policies.

All mills carry workmen's compensation insurance, which is insurance against accidents and injuries that may be sustained by employees around the mill. It also covers occupational hazards. The rate is based on amount of payroll and experience at the individual mill. Officers and directors of the associations are not covered by these policies unless they are specifically listed in the policy as being included in the coverage.

Boiler explosion insurance is carried by all cooperative mills. Rates are based on types and kinds of boilers. This insurance covers the boiler, other property of the mill, and property of others in case of explosion. Use and occupancy or business interruption insurance may also be written in connection with boiler explosion policies. These policies often cover air tank explosion also.

Only two mills carry motor insurance and breakdown insurance on engines. This insurance is against total or partial loss of business due to motor or engine trouble. In this insurance, motors and engines are subject to inspection by the insurance company before writing the policy. They must not be overloaded and must be in good repair.

Seven mills carry use and occupancy or business interruption insurance. In addition, two mills carry this insurance in connection with their boiler explosion policies. This is insurance against loss of business during involuntary closing of the mill such as that caused by fire and boiler explosion. Periodic review of policies to adjust for correct values is desirable.

All cooperative mills carry auto and truck insurance policies on automobiles and trucks operated by the association. These policies cover fire and theft, windstorm, bodily injury, property damage, and collision.

All mills carry fidelity bonds also. These cover dishonesty; burglary and theft of merchandise, money, and securities; money orders; and forgery. It is good practice for mills to have the broad form with nominal coverage for all employees with key employees covered for larger amounts.

All mills carry public or general liability insurance. This is insurance against damage to adjacent property and bodily injury to persons on the property.

Four mills carry product liability insurance, which is coverage against damage that may result from the use of products manufactured and sold by the mills.

In addition to the kinds of insurance already mentioned, one mill carries life insurance on its manager. Others have sprinkler insurance which covers damage from the accidental breaking of sprinkler heads or leakage in the system.

Rating bureaus establish insurance rates with approval of the State Insurance Commission in each State for each mill in that State. In connection with workmen's compensation, average loss at the mills determines rate. If the loss experience at a particular mill is good, it can obtain a reduction in rates.

With respect to fire and extended coverage rates, arrangement and type of construction of the various mill buildings, distance between buildings, fire walls, and availability of fire fighting equipment -- both mill owned and municipally owned -- are important factors in rate making. Mill location with respect to adjoining property and its value is also important. For example, an oil mill located in a highly industrialized area could expect to pay higher insurance rates than one located outside such an area.

Type of mill is also a consideration in rates paid on fire and extended coverage insurance. Other things being equal, the rate on a solvent unit might be higher because of the explosive character of the solvent used, at least, until some "loss" experience has been built up. Good housekeeping helps reduce rates.

Another variable affecting cost of facilities insurance is length of time for which the policy is issued. For example, a 3-year policy will cost 2½ times the 1-year premium and a 5-year policy costs 4 times the annual rate. Seven mills use a 3-year policy in insuring their buildings and facilities. Three mills use 5-year policies, three mills use 1-year policies, and one mill uses a combination of 3- and 5-year policies. Only annual policies are written to cover seed and products in storage.

Fire and extended coverage rates on facilities at cooperative mills are far from uniform for the reasons listed. Rate information available on 10 mills for the 1953-54 season showed a range from $0.62 per $100 of insured value to $3.22 per $100. Three mills enjoyed a rate of less than $1, four mills had rates between $1 and $2, two mills between $2 and $3 and one mill over $3. The high mill had a rate more than 5 times that of the low mill.

Marketing Risks

In the absence of price supports on products, protection against price decline from the time cottonseed is received until products are manufactured and sold is no doubt one of the most difficult problems that faces cooperative cottonseed oil mills.

As already indicated, cottonseed moves to oil mills rapidly in the fall. During the 6 years, 1948 through 1953, oil mills in the United States received on the average about three-fourths of their total annual receipts in September, October, and November. The importance of price protection is emphasized by the fact that almost half the seed was received by the end of October while only about one-fourth had been crushed up to that time. Over 95 percent of the seed was received by the end of December and only about 50 percent had been crushed.

Product prices may change considerably between the time seed is delivered to the mill and the time products are manufactured and ready for shipment. Such an operation involves considerable risk, which the association attempts to minimize in one way or another. There is no rule-of-thumb method to follow in trying to avoid or minimize price risks.

Under operation of the cottonseed price support program of the U. S. Department of Agriculture carried on for the crop years 1950 through 1954, the Commodity Credit Corporation agreed to take a specified amount of oil, meal, and linters at specified prices from mills which paid specified prices to growers for seed. These prices served as a floor with the government assuming the risk of price changes.

It has been pointed out that more than half the cooperatives advance the full market price for seed in the area at the time it is delivered to the mill, while the rest advance something less. There is no organized spot or futures market for cottonseed, such as prevails for cotton and most grain. Mills in a given area, however, usually pay the same price for cottonseed.

The price paid for seed by cottonseed oil mills is based primarily on anticipated outturn of products and prevailing prices for them at the time seed is received, or on anticipated prices for products at the time they will be ready to market. Competition sometimes causes prices paid to be somewhat out of line with what products from the seed will bring. In any event, the big problem is to synchronize at the time seed is received, the sale of the products with their scheduled delivery when they are ready for shipment.

When an association advances full market price for cottonseed at time of delivery, it takes considerable risk. If the association fails to realize enough out of the products to make up for the price paid for seed and conversion expenses, patrons must stand the loss. Where the grower gets less than prevailing market price at time of delivery, he takes the risk individually as a patron as far as any further advances are concerned. The purpose of advancing less than current market price for seed at time of delivery is mainly to reduce risk to the association in case product prices decline after seed is delivered. Members are also contributing their pro rata share to financing the seed prior to its processing.

Increased use of mechanical harvesters is accelerating movement of cotton to gins in the fall and consequently that of seed to mills. This creates a problem of adequate storage and also increases risks of probable price fluctuations. It sometimes requires 10 to 12 months for mills to crush seed received during 3 or 4 months in the fall. In most cases under these circumstances, an association will attempt in some way to protect itself at the time the advance is made on seed. Complete protection under such circumstances is rarely possible.

Officials of cooperative mills follow different methods in their attempts to reduce the risk involved in their operations. The principal method is by making forward spot sales of crude oil and meal and to a lesser degree linters and hulls at the time seed is delivered. On rare occasions, mills use the futures market. Either of these methods may be used or a combination of the two depending on circumstances.

It is common practice for cottonseed oil mills to sell products forward at the time seed is received. In some cases all four products are sold but usually it is only the oil and meal. In selling oil and meal forward, the procedure is to sell the quantity of crude oil and meal to be obtained from seed as fast as seed is received with delivery of products scheduled for the month in which seed will be milled. At some mills, the policy is not to sell products forward too closely in order to have them for immediate sale at all times.

Generally, a larger percentage of oil is sold for forward delivery than of any other product. This is probably because (1) oil is the most valuable product in seed, (2) there is a limited market outlet for oil, and (3) crude oil deteriorates rapidly in storage. The only outlet for crude oil is to a refinery. Outlets for meal are more diversified. As already stated, some mills sell considerable quantities of meal to local consumers. Generally, these mills may make forward sales only for that portion of meal they estimate will be in excess of local demand, although some forward selling of meal to large local consumers takes place.

The price of linters is sometimes protected by selling for forward delivery as seed is received, and in some cases a mill will contract its

entire season's production to one linter buyer. In other cases, sales may be made only as the linters are produced.

Hulls are usually sold pretty much as they are produced, particularly in the nonlivestock areas. Forward selling is not a common practice except to large commercial feeders.

Forward sales of products are usually made for delivery in from 2 to 4 months although sales for delivery 6 months ahead are not uncommon. Table 9 shows oil sales pattern for 14 cooperative mills for 7 months during the 1951-52 season. It will be noted that October was by far the biggest sale month followed by November and December which ties in rather closely with seed receipts shown in table 10. November was the month of heaviest oil delivery. Other heavy delivery months for oil were December, October, and January in that order. Fifty percent of the sales were made for delivery either in the current month or the month immediately following. (Table 11.) In selling oil for forward delivery, 6 or 7 months seems to be the limit for delivery.

Selling products forward at the time seed is received provides satisfactory protection since, theoretically at least, processing costs and margins are taken into consideration in arriving at the payment to be made for cottonseed. Thus when products can be sold forward at the time cottonseed is purchased, costs and margins are practically assured. There are important limitations to this method of protection, however. At times it is practically impossible to sell products forward at all or at least at a satisfactory price at the time cottonseed is purchased. In case of serious price declines after forward sales have been made, it is often difficult to get the buyer to give shipping instructions or take delivery of products. This may be especially true for meal, linters and hulls.

During heavy movement of cottonseed to mills in the fall, the amount of products offered for forward sale usually exceeds the amount purchasers of these products are willing to take at a satisfactory price. Product prices tend to become lower the further the scheduled delivery month is from the sale month, since consumers of mill products also face the possibility of price declines for products they market. This complicates the problem of protection against price declines. When forward sales of oil and meal cannot be made on a satisfactory basis, the only other possibility for protection is to use the futures market.

There are no organized futures markets for cottonseed, crude cottonseed oil, linters, or hulls. Only two products, refined oil (New York)[17] and meal (Memphis) can be bought and sold on the futures market.

[17]Since this report was prepared, the Chicago Board of Trade has opened futures trading in crude cottonseed oil.

Table 9. - *Oil sales and scheduled delivery pattern for 14 cooperative cottonseed oil mills, July to January, 1951-52 season*

Sale month	Tank cars by delivery month												
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	Total
July	-	23	-	-	-	-	-	-	-	-	-	-	23
August	-	31	77	66	13	12	15	11	4	-	-	-	229
September	-	-	84	75	60	2	-	2	6	-	-	-	229
October	-	-	-	124	181	122	42	26	38	12	10	-	555
November	-	-	-	-	41	116	81	69	54	29	3	-	393
December	-	-	-	-	-	30	68	39	35	43	44	30	289
January[1]	-	-	-	-	-	-	56	43	17	19	28	28	191
Total	-	54	161	265	295	282	262	190	154	103	85	58	1,909

[1]Only a part of January is included for some of the mills.

Table 10. - *Seed receipts and seed crushings by cooperative cottonseed oil mills, July - January, 1951-52 season*[1]

Month	Seed receipts[2]				Seed crushings			
	During month		Cumulative to end of month		During month		Cumulative to end of month	
	Tons	Percent of total	Tons	Percent of total	Tons	Percent of total	Tons	Percent of total
July	18,536	4.4	18,536	4.4	6,432	1.6	6,432	1.6
August	32,826	7.8	51,362	12.2	11,565	2.8	17,997	4.4
September	63,529	15.0	114,891	27.2	33,692	8.5	51,689	12.9
October	132,678	31.3	247,569	58.5	51,593	12.5	103,282	25.4
November	104,875	24.8	352,444	83.3	50,857	12.3	154,139	37.7
December	55,297	13.0	407,741	96.3	47,389	11.6	201,528	49.3
January[3]	11,366	2.7	419,107	99.0	38,374	9.4	239,902	58.7
Estimate to end of year	4,411	1.0	423,518	100.0	168,616	41.3	408,518	100.0
Estimated total	423,518	100.0	-	-	408,518	100.0	-	-

[1]Fourteen mills.

[2]Seed received for crushing only - does not include seed received and sold as seed.

[3]Only a part of January is included for some of the mills.

Table 11. - *Extent of forward selling of oil for 14 cooperative cottonseed oil mills, July - January, 1951-52 season*

Sale month	Tank cars of oil for delivery in:								
	Sale month	1 month following sale	2 months following sale	3 months following sale	4 months following sale	5 months following sale	6 months following sale	7 months following sale	Total
July	0	23	-	-	-	-	-	-	23
August	31	77	66	13	12	15	11	4	229
September	84	75	60	2	-	2	6	-	229
October	124	181	122	42	26	38	12	10	555
November	41	116	81	69	54	29	3	-	393
December	30	68	39	35	43	44	30	-	289
January[1]	56	43	17	19	28	28	-	-	191
Total	366	583	385	180	163	156	62	14	1,909
Percent of total	19.17	30.54	20.17	9.43	8.54	8.17	3.25	.73	100.00

[1]Only a part of January is included for some of the mills.

Only four cooperative mills reported any use of the futures market for hedging oil, and that to a limited extent. Hedging must be in refined oil and cooperative mills (with two exceptions) have only crude oil for sale. Crude oil is not deliverable against a refined oil contract. Consequently, hedging in refined oil when only crude is produced is not an entirely satisfactory method of protection, since the spread between crude and refined oil prices does not remain constant.

Only one cooperative mill reported use of the cottonseed meal futures market. Meal futures can be bought and sold only through the Memphis Board of Trade at Memphis, Tenn. Delivery points are restricted to an area fairly close to Memphis. These points are so situated that mills located away from the Mississippi River Delta area feel they cannot afford to use this futures market since, if they were forced to make delivery, freight rates would be prohibitive. They feel it is definitely not a satisfactory market.

It should be pointed out that use of the futures market for hedging price risks is not speculation. It is a means of reducing price risks. It should be understood that even though a mill hedges its purchases of cottonseed by selling refined oil and meal on the futures market, it cannot be certain that all risks will be eliminated or even that a loss will not occur.

Hedging would afford protection against loss through price changes if spot prices and futures prices of commodities dealt in on the exchange always moved up or down together and by exactly the same amount. Under such circumstances, a mill could protect itself against price changes in cottonseed meal by taking an exactly opposite position in the futures market. Any loss or gain in spot prices would be offset by compensating gains or losses in futures prices. Unfortunately hedging is not as simple as this, because spots and futures rarely move up or down together.

No method of protection offers complete insurance against price risks. For example, it is impossible to overcome effects of changing relationships between spot prices of crude oil and futures prices of refined oil. In general, however, risks incident to these changes in spots and futures are usually less than risks in carrying commodities completely unprotected.

Payment of Patronage Refunds

One of the fundamental principles of agricultural cooperation is distribution of sales proceeds less costs according to patronage. Cooperative cottonseed oil mills adhere strictly to this principle. However,

the methods used to achieve this result are not the same at all mills. A typical condensed operating statement might be:

Blank Cooperative Cottonseed Oil Mill:
Statement of operations and margins
for the year ended June 30, 1954

Tons crushed		25,000
Sales proceeds:		
Oil		$1,250,000
Meal		750,000
Hulls		150,000
Linters and motes		350,000
Total		2,500,000
Processing costs:		
Manufacturing cost	$375,000	
General and administrative expenses	100,000	
Total conversion cost		475,000
Proceeds from operation		$2,025,000
Other income	$125,000	
Other expenses	100,000	
Net other income		25,000
Proceeds available for distribution		$2,050,000
Proceeds distributed as follows:		
Initial advances on seed including freight cost		$1,500,000
Subsequent advances on seed		375,000
4 percent dividend on preferred stock		25,000
Cash patronage refund		50,000
Preferred stock issued		80,000
Allocated reserves and equities		20,000
Total		$2,050,000

It will be noted that conversion costs are deducted from gross sales of all products to arrive at proceeds from operation. To this is added other income. When other expenses are deducted proceeds available for distribution remain.

All cooperative mills base their seed advances and patronage refunds on tons of seed delivered. However, methods of figuring the allocations differ somewhat.

Most associations determine the final payment a patron receives for his seed in about the same manner. They pay the current market price, or an advance, for seed at time of delivery or as soon thereafter as grade can be determined. They make subsequent advances as justified. At the end of the season after stock dividends are paid any overage is distributed on a tonnage basis.

According to figures in the typical statement, the patron would receive in cash his proportional share of total seed advances, a 4 percent dividend on any preferred stock held, the face amount of any preferred stock retired and the cash patronage refund.

In addition to these cash receipts, the patron would receive his proportional share of any stock or certificates issued and receive credit for any allocated reserves or equities from the year's operations. This would represent the money retained by the mill for capital purposes and subject to redemption as operations justify. The revolving of capital is good cooperative practice in that current patrons of the mill furnish their proportionate shares of the capital.

Patronage refunds are usually the same amount per ton for all patrons. However, the total amount received per ton during any season could vary somewhat from patron to patron. If the initial advance is according to current market prices, there may be considerable variation in amounts received due to fluctuating prices of cottonseed during the delivery season. Cottonseed prices do not usually change often nor drastically during a season. Four or five changes each year might be normal.

If initial payments are made according to grade, this also will result in differences in amount advanced as between patrons, since grades will differ between patrons. These differences are greatly minimized if all patrons deliver their seed to the mill over the entire season, if grades are uniform, and if the area from which the mill receives seed is small. Price and grade changes would then affect each patron alike.

Grade change inequities between patrons could be reduced by allocating patronage dividends according to dollars paid for seed rather than tons of seed delivered. In allocating on a tonnage basis, the only credit the patron receives for grade is in the initial advance. He doesn't share in the patronage dividend on a grade basis. On a dollar basis, he would be given credit for his grade in the patronage dividend.

For example, a mill is able to pay $10 patronage dividend. On a tonnage basis each patron would get $10 for each ton delivered during the year. If it were on a dollar basis, a patron who had delivered 110 grade seed would get $11 per ton dividend while a patron who delivered 95 grade seed would get only $9.50. One who delivered 90 grade would receive $9.

The amount of initial advance is important only insofar as it provides the patron with ready cash in advance of the time when the association

knows final results of its operations at the season's end. In a cooperative everything that remains after all expenses of operation are paid belongs to patrons and should be prorated among them according to the patronage of each in the association.

Other Services to Members

In addition to crushing cottonseed the cooperative mills perform other services for their members.

Sidelines

Members of many mills realize other benefits through their cooperatives in the form of sideline activities such as the handling of bagging and ties, planting seed, insecticides, and mixed feeds.

In 1952-53, 10 mills together handled over a million-dollar volume of bagging and ties for members. Most of these mills handled the items at or near cost as a convenience for their members. A seed truck can deliver a load of seed to the mill, pick up bagging and ties, and return them to the member thereby helping to reduce their cost. The mill by ordering in quantity may be able to buy at lower cost. In times of scarcity, the mill may be able to obtain bagging and ties when an individual member cannot.

Four mills handled nearly $400,000 worth of planting seed in 1952-53, and three mills handled about $50,000 worth of mixed feed, exclusive of "20-80" mix.

Mills sold a few other supplies in small quantities. Five mills supplied poison or sprays and insecticides of various kinds. One mill handled a few gin supplies such as electric motors and another, sprayers and fertilizer equipment.

In most cases, any savings realized on sideline activities are small since these are largely service activities for the convenience of members. In many instances, small losses occur. Such savings or losses are usually added to or deducted from cottonseed crushing operations. Any patronage refund is included with those on cottonseed. However, one mill pays a separate patronage refund on bagging and ties and another mill, on planting seed. Most mills feel that handling these sidelines improves membership relations and helps to maintain seed volume.

Operating Loans

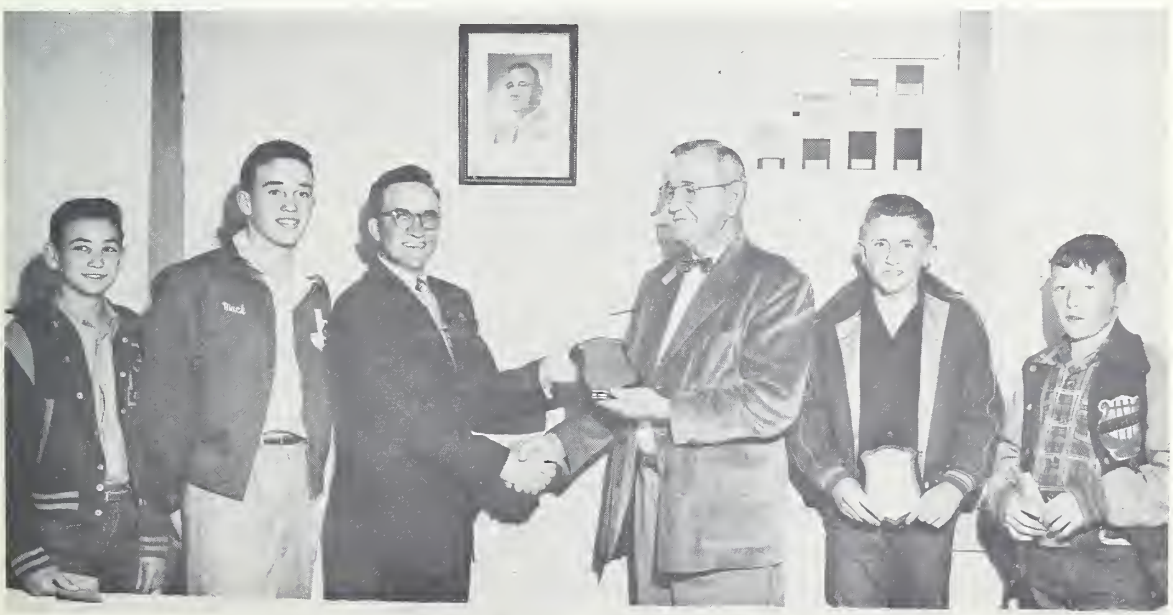
Most mills advance operating money to their member gins in summer and fall. This is largely to enable members to begin operations before returns from the seed are large enough to meet operating costs, buy bagging and ties, and make gin repairs. Mills that follow this practice feel they must do so to meet competition and maintain their seed volume. In some cases, this money is repaid directly and in others it is deducted

from amounts owed the gin member for seed. Two mills encourage their members to leave the money due for seed at the mill. Three percent interest is paid on such funds. Some mills charge interest on operating funds advanced to members while others do not.

Methods of Improving Public Relations

For the most part, officials of cooperative cottonseed oil mills take an active part in community affairs and enter into the business life of their towns and communities. Over half of them are affiliated with their local Chamber of Commerce and local Farm Bureau. Officials of a number of mills are members of such organizations as Rotary, Kiwanis, Business Men's Clubs, Lions, and Agricultural Clubs. On request, they frequently make talks to interested community groups on cooperative business. Some mills permit such local clubs to use their board of directors' room as a meeting place. They make their kitchen facilities available for serving meals. This builds goodwill for the associations. Many of these mills invite local businessmen to attend the association's annual meeting.

To stimulate interest in cooperatives among young farm people of the community, over half the mills have been participating in FFA and 4-H Club activities. They have promoted calf feeding contests, sponsored calf shows, bought top calves produced, sponsored trips to camps, and furnished prize money for producing cotton and other things of this nature. For many years, a number of mills have sponsored tours for schools and vocational agriculture groups. Where the cooperative gin is a member of the mill, it has been encouraged to send groups to the mill.



The late G. L. Jackson, former President, Plains Cooperative Oil Mill, Lubbock, presented plaques and checks to top 4-H Club cotton growers on the South Plains of Texas.

Local and State fairs have furnished a means of contact with people in other businesses. One mill puts up an exhibit of its cooperative activities, one assists the Junior Chamber of Commerce in getting ready for the fair, and another contributes to the advertising for the fair. In another instance, a cooperative mill joined with its two competitors in the same community and put on a joint exhibit at a large area fair.

On the National level, most cooperative mills are members of the National Cottonseed Products Association, and the manager of one of these mills is on the board of directors. All but three mills are members of the National Cotton Council. Half the mills are members of the American Institute of Cooperation and four are members of the National Council of Farmer Cooperatives. Practically all mills are affiliated with one or more State or regional crushers or ginners associations and cooperative educational organizations.

Superintendents at practically all cooperative mills are members of the International Oil Mill Superintendents Association. The superintendent at the Plains Cooperative Oil Mill, Lubbock, Tex., was elected president of this organization for the year 1954-55.

The manager of the Plains Cooperative Oil Mill is a member of the Cotton and Cottonseed Advisory Committee of the U. S. Department of Agriculture. It is the duty of this committee to make recommendations to the Department on research work pertaining to cotton and cottonseed.

This fair exhibit set up by one of the large cooperative cottonseed oil mills shows a replica of the mill, cottonseed and its products, and "satisfied" cattle eating feed made from cottonseed meal and pellets.

Increased Member Returns

Cotton growers have organized cooperatives and established oil mills to increase their incomes and get certain other benefits already mentioned. Experience has shown the price they received for cottonseed, including patronage refunds, has been substantially higher than the average farmer's income from cottonseed.

Examination of the spread between the farm price of cottonseed and value of products obtained from seed for the period 1947-48 to 1953-54 shows a wide margin for the United States as a whole. (Table 12.) Of course, these spreads include all costs of obtaining, transporting, and processing seed and also profits of seed merchants (primarily ginners) and oil mills. Variations in the spread will occur between States and areas so that for any given location the spread may be greater or smaller than the table shows.

Table 12. - *Average value of cottonseed products produced per ton of seed crushed,*[1] *farm price of cottonseed*[2] *and spread between the two, United States, 1947-48 to 1953-54*

Year	Value of cottonseed products per ton crushed	Farm price for cottonseed per ton	Spread between total value and farm price
1947-48	$138.51	$85.90	$52.61
1948-49	86.43	67.20	19.23
1949-50	80.23	43.40	36.83
1950-51	134.35	86.40	47.95
1951-52	100.49	69.30	31.19
1952-53	98.94	69.60	29.34
1953-54	85.82	52.70	33.12

[1] Oilseeds, Fats and Oils and their Products, 1909-53, Statistical Bulletin 147. U. S. Dept. of Agric. (1947-52) 1953 figures calculated.
[2] Agricultural Statistics, 1954. U. S. Department of Agriculture.

Table 13 presents data showing the difference between the amount cooperative mills returned to patrons for seed and farm price of seed. The farm price data are weighted averages for Arkansas, California, Mississippi, Oklahoma, and Texas which are the only States where cooperative mills are located. Returns by mills to gins include transportation charges and may be subject to some overhead deductions before being passed on to individual farmers.

Table 13. - *Average cooperative mill return to patron, average farm price,*[1] *and cooperative mill patron advantage per ton of cottonseed, selected States,*[2] *1947-48 to 1953-54*

Year	Average cooperative mill return to patron per ton of cottonseed[3]	Farm price for cottonseed per ton	Co-op mill patron advantage per ton
1947-48----------	$119.01	$87.82	$31.19
1948-49----------	77.07	69.61	7.46
1949-50----------	69.91	43.79	17.12
1950-51----------	121.62	88.52	33.10
1951-52----------	91.17	71.31	19.86
1952-53----------	92.86	70.28	22.58
1953-54----------	73.66	53.10	20.56
Average----------	88.50	66.84	21.66

[1]Agricultural Statistics, 1954. U. S. Department of Agriculture.
[2]Arkansas, Mississippi, Oklahoma, Texas and California.
[3]Including in-bound freight on seed.

The mill's return to the patron consists of sales proceeds less costs incurred. There are variations among mills with respect to the amount returned by years and between years. Such factors as volume and quality of seed, crushing efficiency, and location can materially affect the returns a mill is able to make. However, figures in tables 12 and 13 indicate that farmers have benefited substantially in organizing their own cooperative oil mills.